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J. M. WAKEMAN, - - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - Associate Editor.

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THE LATEST WIRELESS FEAT.

Although the American Institute of Electrical Engineers made Mr. Marconi its guest of honor at the recent annual dinner, and acclaimed his feat in sending and receiving a telegraphic signal without wires across the Atlantic, there have been a great many persons who doubted the actuality of that feat. We have talked with some of them; while others are certainly engaged in editing our esteemed contemporaries in England, where their comments on Mr. Marconi have been of the most grudging and depreciatory character. In common with the daily newspapers, we now record achievements that make the Poldhu-St. Johns signaling quite insignificant, while this time Mr. Marconi has taken care to get records and witnesses. He is fully entitled to the heartiest congratulations, and we are glad to note that the Nestor of the science and art, Lord Kelvin, who first made submarine cabling feasible, is first to tender felicitations to the brilliant young inventor whose perseverence and grit have made the latest and greatest results possible. We have seen the attested records for ourselves. Mr. Marconi's word was enough for us, but it is something to have the documents which can be deposited in archives and national museums for the benefit of the incredulous and of posterity.

We publish, from the pen of Mr. Wilfrid Blaydes, a member of Mr. Marconi's staff, a report of the recent trip of the "Philadelphia," and we accompany his very interesting narrative by a reproduction of the signal received at 2099 miles—more than the Newfoundland record. The ease with which the whole thing was done is all that surprises us, and it compels us to expect greater results in the near future. In England, the Postmaster General may still dispute with Mr. Marconi his right to use any portion of the land. This is only in keeping with the policy that darkened the electric light, blocked the electric railway and strangled the telephone. But on the sea and on other shores Mr. Marconi and other workers in this great new field may surely look for kinder treatment. So far as the sea is concerned, it seems to us that the compass, the lighthouse and the wireless telegraph are the trinity of safe navigation.

"CAPTAINS OF INDUSTRY."

We were able to note briefly last week the breakfast given to Prince Henry of Prussia by twelve of the leading citizens of New York, at which a number of "captains of industry," "industrial notabilities" and "men of insight on the matter"—as Carlyle put it 50 years ago—were invited to meet the Prince. The idea had been submitted for approval to the German Emperor, who, with his usual quickness of perception, was prompt to approve so admirable a plan for bringing his brother in touch with those who conduct or who have helped to create the gigantic industries that are such a marked feature of American development. It is with pleasure that we call attention again to the prominence given to men connected with the electrical arts.

Before enlarging on this point we may note that there seems to be some little misunderstanding as to the invitations to this affair, these criticisms being based upon the list of acceptances. We happen to know, from inquiry, that about twice as many invitations went out as there were acceptances, and this result was inevitable, as a great many well-known men worthy of the honor were scattered all over the country and could not make the long trip to New York. But even of those who were there, the percentage of men of other distinction than that of wealth was remarkable, showing upon the part of the hosts a fine appreciation of the fitness of things, equaled only by the

quiet good taste that characterized the whole management. A printed list of 92 present, if analyzed roughly, shows only 24 "wealthy" men, and each of these stood for some great system of railroads, life insurance, etc. Of those representing industries distinctively there were 28, some rich, but often leaders because of their ability and energy. There were 10 educators, some of them leaders again in other groups; and no fewer than 30 inventors and engineers. In fact, this group ought to include some of the names in the other classes, but even as it stands in our rough analysis, it is the biggest batch of the lot.

To say nothing of men in the other groups interested in electrical work, we may note that of the 30 inventors and engineers, no fewer than 12 are distinctively electrical, and we should be justified in including one or two other names also; but the 12 are these: Edison, Thomson, Bell, Westinghouse, Brush, Weston, Sprague, Pupin, Hall, Acheson, Tesla, Steinmetz. This is assuredly a typical list, and a splendid compliment, but we should be warranted in claiming for is also from the other groups the names of Crocker, A. E. Brown, G. G. Ward and Vreeland—making 16 in all. Whatever may be thought of this proportion by those in other fields of work, electrical engineers can but contemplate it with pleasure.

WIRES AND STORMS.

The recent storms have caused so much havoc among aerial circuits between the Alleghanies and the Atlantic seaboard that even now the telegraph and telephone circuits are not working at their full efficiency. The great centers of population, trade and government have been out of touch with each other, and it is not to be wondered at that there should be an agitation for putting all the wires underground. But the thing is easier said than done, and European instances have little weight in view of our "magnificent distances," some of which Prince Henry has been testing. That more wires between the cities could and should be put underground is true, but the floods have been out lately as well as the snows and winds; and on the whole, it would seem as though aerial wires had rather the best of it, as compared with those in ducts. Stronger construction than some of the newer telephone and telegraph circuits it would be hard to find; and when they succumb the weather is indeed exceptional. In spite of the clamor we do not expect to see much long-distance underground work attempted; but it is certainly worth the trial in some districts, and we hope that the Pennsylvania Railroad will carry out its reported intention of putting into conduits as many of its wires as possible between New York and Philadelphia.

A NOTABLE WATER POWER SYSTEM.

The detailed report of the operation of the Hartford Electric Light Company during the last decade, presented in the current issue, is exceptionally interesting and instructive. It displays in the most striking manner what can be done in a city of moderate size by a progressive and energetic management, and presents an excellent instance of a combined steam and water plant worked under sound and economical conditions. Within the past 10 years its load has increased nearly seven-fold, and its income has been correspondingly enlarged both in gross amount and net earnings. This conspicuous success is the more gratifying since it has been attained by broad methods and even daring innovations. The part in electrical pioneering which has been played by the Hartford plant is a very notable one, and it has reaped a far greater reward than comes to the ultra-conservative. Starting as a steam station it was the first American plant to appreciate the value of modern methods in power transmission from water power; the first to order polyphase transmission apparatus; the first to experiment with enclosed arcs; if we mistake not the first central station to install 60-cycle rotary converters; the first to adopt the constant-current alternating arc system; the first to adopt in this country the steam turbo-generator as a part of its regular equipment; and the first to commercially introduce the Nernst lamp! If some astute inventor steals the glow-worm's secret and puts it on the market, we would be willing to wager a reasonable amount that the Hartford Electric Light Company would install the first plant on the new system.

The use of water power at Hartford has been wise and successful. Ten years ago it put in a three-phase generator and synchronous motor to help out its steam plant, working over a 5000-volt line. To-day instead of being a steam station with a water power auxiliary, the tail is wagging the dog, and it is a water power transmission plant with a steam auxiliary. The management early grasped the fundamental fact that the economy of water power depends on the complete utilization of the power, and went to very large expense in reorganizing the plant with storage battery sub-stations so as fully to utilize their hydraulic resources. The business of the system has been continuously pushed forward until the whole available water has been taken up and steam has to be used in rather large amounts to take care of the surplus. Consequently, while water power plants have sometimes proved very costly to operate on account of the heavy fixed charges that have had to be borne by a comparatively small paying load, the Hartford station, with coal at a price that would enable it to compete on favorable terms with many hydraulic stations, has made its transmission from water power a paying proposition. And it has done this in spite of that fact that it has borne in this as in many things the brunt of considerable experimentation.

The growth of motor service in Hartford has been remarkably rapid. Both two-phase and direct-current motors are in use, as both systems are also in use for lights, and the company has not made that rather common mistake of adhering slavishly to one system because it happened to be the one first used. A part of its field is very compact, and in this the original three-wire system is in successful use; but when the need arose the management did not hesitate to put in alternating-current lights and motors wherever they would do the most good—an example which might profitably be followed by many others. Having available an alternating system of practicable frequency, the company was prepared to take up a novelty like the Nernst lamp without inconvenience. When the demand for this lamp becomes general, or when alternating arcs are substituted for other types, the Hartford Electric Light Company will be ready for business without a wholesale scrapping of apparatus. Its whole attitude has been one of shrewd foresight, and in its enormous increase of business it has but reaped the reward that was its due. Its experience ought to encourage the more general use of transmitted power and fearless innovation when innovation will pay. It is not every plant that has access to a cheap source of power, nor every one that realizes that water power is cheap only when it can be fully utilized. What a proper hydraulic development can do is powerfully in evidence in the work at Hartford, and what this, coupled with sound judgment and good management can do for the business of a plant, is written so that he who runs may read. It is real pleasure to be able to chronicle so notable an achievement.

GENERATOR HEATING LIMITS AND THE A. I. E. E. STANDARD.

A communication in our correspondence columns refers to a matter of considerable practical importance. The rating of a dynamo-electric machine is ordinarily limited by its temperature elevation. The temperature elevation that may safely be allowed depends upon the final temperature. The final temperature must not exceed a safe limit. Consequently, the load which a machine will carry in order to reach the assigned final temperature will be markedly greater when the machine is operated at a very low temperature in the arctic zone, than when operated on a summer day in a steam engine station near the tropics. But the commercial rating of the machine is assigned by the A. I. E. E. rule for a standard normal temperature of 25 degs. C., with a temperature elevation of 50 degs. C. The safe load will

then be greater or less than the commercial rating, according to the local surrounding temperature. Some machines employ insulating materials which are not injured by a temperature of 150 degs. C., while other machines are liable to be injured by reaching a temperature of 100 degs. C. The safe load must, therefore, be considered for each type of construction, and each local temperature of surroundings.

To take a single supposititious case, a machine might be built which had a rating of 500 kw according to the A. I. E. E. rule of not exceeding 75 degs. C. in any part, when the temperature of surroundings is 25 degs. C. If the safe limiting temperature of the machine under load were, say, 100 degs. C., then the output of rating could be obtained if the engine room temperature were 50 degs. C., leaving, however, no margin for overloads. With a safe limiting temperature of 90 degs. C., the safe load of the machine would be less than the load rating unless the room temperature were lower than 40 degs. C.

THE ENGLISH VERSUS THE METRIC SYSTEM.

On another page we print a curious communication from Mr. Charles T. Porter. For the benefit of our younger readers we will say that Mr. Porter is well-known in the history of the steam engine as the business partner of the gifted inventor, the late John H. Allen, in the development a generation ago of the high-speed steam engine. Mr. Porter, in the first place, is, we believe, incorrect in his statement that a bill is before Congress "which will make the use of the metric system compulsory in this country." The fact is that the bills in question seek to make the use of the metric system compulsory in United States Government departments and offices; but in this land of liberty no man can be restrained from either measuring or stating the height of his horse in "hands," or the area of his barn in "poles," as long as it shall please him so to do. In Germany there are still to be found a few who prefer to express lengths in terms of the defunct German inch, or "zoll," which was superseded by the metric system. The few are regarded as harmless victims of conservative idiosyncracy. If the Society of Mechanical Engineers is endeavoring to bar the way to the metric system, we must express extreme regret at such action; and in view of the testimony given at committee hearings in favor of the bill now before Congress by representatives of some of the largest engineering interests in the country, we doubt if adverse action on the part of the Society's governing body expresses the voice of a majority of its members. Of all classes of men, mechanical engineers have done most to develop civilization by the introduction of labor-saving devices. The metric system is merely a labor-saving device for dealing with magnitudes, just as our decimal system of coinage is a labor-saving device for effecting exchanges over its predecessor, the guinea-pound-shilling-penny-farthing system. Hence the anachronism of the deed. Unless history beguiles, there was a time in the days of Rome when the Arabic numerical notation was unknown, and all numerical computations had to be performed in Roman numerals. What must have been the labor involved in finding the product of two such numbers as 365 and 24 when those numbers were expressed as CCCLXV. and XXIV., respectively. There were regular rules for conducting the campaign. The saving of labor to the community effected by replacing the Roman by the Arabic numerals must have been enormous, and yet the change met, it is said, with vehement opposition among professional computers.

Mr. Porter's strange view is that the English system is preferable for the reason that it employs a variety of units, and he gives as an example the mile, yard, foot and inch, each of which is recommended for use in dealing with appropriate dimensions. So far as this argument claims any advantage over the use of the kilometer for roads, the meter for short distances and the centimeter and millimeter for smaller lengths, it seems only to recommend diversity and complexity of numerical ratios. Of the same order of distinctive use and procedure would be the denomination of all house lengths in feet, all church lengths in yards, all ship lengths in cables, all horse lengths in "hands," etc. How distinctive such a system might be made! As to the matter of the decimal point, sums of money are always expressed, in our decimal ssytem, in the largest suitable unit, commencing with mills and proceeding with decimal strides to billions. If these numbers are written down there is always a danger of error from an accidental misplacement of the decimal point. A man who writes his income as ten thousand dollers, carried out to cents, is liable to make his income appear as a million dollars, by placing the decimal point at the end, and a similar liability to error occurs throughout the whole range of our decimal arithmetic. It is, however, an unwarranted reflection on the American mechanic's common sense and sense of proportion to imply that the decimal point would demoralize the workshop, and yet by some this objection has been urged as a crucial one.

Granting that the universal screw-thread is an Anglo-Saxon gift to the world, that thread does not require to be abandoned because the metric system is used. Metric-system Europe largely employs the Whitworth screw-thread and merely measures or expresses it in terms of the meter. As for the English inch, "which we have been at immense pains to obtain, with its endless possible bi-section," we all know that it is common among engineers to use decimals of a foot instead of inches, in leveling, and decimals of an inch instead of bisective fractions, in careful shop measurements. The metric system is a scientific system compared with the English system, because of its enormous relative simplicity. The sentiment, "Let other nations come to us. They have everything to gain by doing so," can hardly be commended. By the millions of men and women in the world who use the metric system exclusively, and who relinquished their own primitive units to adopt a uniform system, we hope that this sentiment may not be interpreted as jingoism, but rather as conservativeness enshrined. If our neighbors have a better system than ours, surely we have courage enough to admit the fact.

To our mind, the question of the general adoption of the metric system is entirely a practical one—a matter of dollars and cents—and a philosophical discussion such as that of Mr. Porter has nowadays merely an academic interest. We venture to say that all who have lived any length of time in a country employing the metric system have experienced some surprise at the facility with which they became accustomed to its use in daily life. In making purchases the liter, the kilogramme, the 50 grammes and the meter in a very short time take on an individuality quite equal to the corresponding English units; and the student very quickly finds the centimeter and millimeter adjusted to their linear value in his mind and to his eyes. Not the slightest difficulty would, we believe, be experienced by the American people in assimilating the metric system, while their gain through being able to easily interconnect the various units would be an enormous boon, and the benefit to our export trade incalculable.

In view of the striking fact that technical graduates are rapidly coming to dominate every department in every branch of technical industry, and that these through their thorough school training and their technical reading are not only entirely familiar with the metric system, but, almost to a man, in favor of its practical use, its general adoption in this country would be vastly facilitated. As the system would thus be welcomed by the present younger generation, and would be considered a great boon by the generations to come, the prejudices engendered by conditions existing in the past should not be permitted to obstruct the great reform. According to a report of the British Association advocating the adoption of the metric system by the British Government almost a majority of the House of Commons have pledged themselves in its favor. Since sentiment in favor of the system is rapidly growing in that country as in this, obstruction here is likely to have the sole result to deprive the United States of the credit of accomplishing the reform, which it will then obviously be compelled to embrace from commercial considerations.

Pennsylvania Railroad and Electricity.

The annual report of the Pennsylvania Railroad Company says with regard to electric traction in its tunnel under the Hudson River: "The board have long felt that your interests, as well as the convenience of the public, require the extension of your line into New York and the establishment of a centrally located passenger station in that city, through which the inconvenience and delays of the transfer by ferry will be avoided. The great cost of a bridge excluded that plan, unless all the railroad companies whose lines terminate on the west bank of the North River would join in the undertaking.

"The alternative was the construction of a tunnel line; but the difficulties incident to the operation by steam of a tunnel, at the depth and with the gradients required by the topographical conditions, seemed to make that method almost impracticable. Meanwhile, however, the successful operation of a number of tunnels in different parts of the world by electric power indicated that a satisfactory solution of the problem might be found in the construction of a line, to be operated by electricity, under the North River to a terminal station in New York, and thence under the East River to a connection with the Long Island Railroad.

"Preliminary investigations having favored its adoption, it was thought best to proceed at once to acquire ground for a station upon the location selected. This has been done and the greater part of the necessary property purchased at a reasonable price. The importance and cost of this work, however, and the fact that novel engineering questions were involved, made it the duty of your board, before proceeding further, to have the plans for construction, and, in fact, the whole subject, thoroughly studied by competent engineers. For this purpose a commission was created, consisting of five civil engineers eminent in their profession, namely: Colonel Charles W. Raymond, United States Army, chairman; Mr. Gustav Lindenthal, Mr. William H. Brown, chief engineer Pennsylvania Railroad Company; Mr. Charles M. Jacobs and Mr. Alfred Noble.

"This commission will supervise the preparation of all plans, and will have general control of the undertaking. The two members last named will have direct charge of the work, which has been divided into two sections, the North River section having been assigned to Mr. Jacobs, and the East River section to Mr. Noble. The study of the project has already progressed far enough to establish its entire practicability. The commission will have, in fact, a choice between several feasible plans. The cost of the work will be large, but your board are satisfied that the expenditure will be fully justified by the results obtained."

Telegraph Tournament.

The American Telegrapher's Tournament was held at Atlanta, Ga., on March 1, telegraphers from many parts of the United States being participants. Mr. Andrew Carnegie offered a gold medal for the speediest work, and sent the following message to the secretary of the tournament: "May the records be broken. '73' to all." Mr. Edison also took an interest in the event and sent the following letter:

"Although my business interests keep me well employed, I have decided to accept the honor you have conferred on me. I am much gratified to be a member of a committee composed of the honorable gentlemen whose names you mention. Trusting that the tournament will prove a success in every way, and with best wishes to the fraternity, I remain very truly yours, THOMAS A. EDISON."

Following were the results of the various contests: Transmission According to the Phillips Code—To the fastest sender for five minutes of matter by means of the code, a championship gold medal and $35. Won by F. M. McClintick, of Dallas, Texas; second prize, silver medal and $15, won by F. G. Matthews, of Atlanta.

Straight Morse Sending—To the fastest and most perfect sender for five minutes, a championship gold medal and $35. Won by E. E. Buckner, of Dallas, Texas; second prize, silver medal and $15, won by F. M. McClintick.

The *Atlanta Constitution* gold medal for the most rapid straight Morse sending, won by F. M. McClintick.

The *Atlanta Journal* gold medal, for the "cleanest" copy on a typewriter of five minutes, Phillips code, won by F. M. McClintick.

The message class event was won by H. V. Emanuel, of Philadelphia, receiving 50½ messages in 30 minutes, breaking all records. The best previous record was 50 messages in 32 minutes 17 seconds. J. I. Hilliard, of Memphis, won the consolation prize for straight Morse sending. The Carnegie medal was won by McClintick, who established the world's record for sending.

Electrical Engineers of the Day.—XXXVI.

F. W. ROLLER.

Frank W. Roller, the son of a naval officer—now Commander J. E. Roller, U. S. N.—was born May 29, 1874, in New York City. His early education was received in the public schools of Boston, Mass., and Newark, N. J. From the high school of the latter place he entered the employ of the Sawyer-Man Electric Company in 1889, working first in the dynamo room, then on general wiring work, and finally in the laboratory at the time when experiments looking toward using carbonized silk threads for incandescent lamp filaments were being carried on. In 1890 he matriculated at Lehigh University, from which he was graduated four years later with the degree of mechanical engineer. At Lehigh Mr. Roller's scholarship and attainments entitled him to membership in the Tau-Beta-Pi Society, the college engineering society, an honor reserved for those who stand in the first fifth of their class. After graduation Mr. Roller entered into the employ of Mr. J. A. Machado, with whom he later formed the firm of Machedo & Roller, and entered into general electrical engineering work.

Upon the outbreak of the Spanish-American War Mr. Roller vol-

unteered his services to the Navy Department, and was commissioned a volunteer assistant engineer in the United States Navy, and was at once ordered to the U. S. S. "Nashville." Not long after going aboard the chief engineer of the vessel was ordered to the battleship "Indiana," and Mr. Roller was left to perform the duties of chief engineer until he received an honorable discharge from the service after the expiration of the war. The duties that devolved upon him were more special in character than in the case of a great majority of the vessels engaged in the Spanish-American War. This vessel was equipped in part with high-pressure water-tube boilers, and with quadruple expansion engines running at 300 r. p. m., both then innovations for a vessel of that size. In view of the very special nature of the machinery it was a high testimonial to the ability of the young officer that he was permitted to retain charge of the engineering department until the end of his service.

Upon his return to civil life Mr. Roller resumed his electrical engineering business, and took up in addition thereto much work in the line of mechanical energy. During late years he has devoted special attention to the matter of electrical measuring instruments, in which he has made several improvements and been awarded several patents. He has also done considerable work on small boilers and engines, and taken out patents on these and on an ingenious form of metallic packing.

Mr. Roller is a member of the American Institute of Electrical Engineers, the American Society of Naval Engineers and Franklin Institute.

Development of a Great Water Power System at Hartford, Conn.

BY ALTON D. ADAMS.

ELECTRICAL supply in Hartford, Conn., is notable for its rapid increase, the utilization of water power, and the system of transmission and distribution by which it is effected. The Hartford system includes three generating plants, two driven by water and one by steam, a sub-station of transformers and rotary converters in connection with the steam plant, a separate sub-station with transformers, rotary converters and a large storage battery, and two transformer stations for street lighting with series arcs.

The two water power plants are located on the Farmington River at points about three miles apart in the towns of Windsor and East Granby, respectively, one plant being approximately 10.5, and the other a little more than 11 miles in direct line from the steam station in Hartford. The Farmington River rises among the Berkshire Hills of Western Massachusetts, more than 50 miles above these electric power stations, and has a comparatively large drainage area. The flow of water in this stream, though subject to some variations, is large at all times of year, as may be seen from the electrical outputs of the water power stations, shown later on. The head of water available at the plant in East Granby is about 23 ft., and that at the station in Windsor 32 ft. The plant in Windsor is known as No. 1, and that in East Granby as No. 2, while the steam station in Hartford is spoken of as No. 3.

The earlier water power plant, or No. 1, is at a point called Rainbow, and the later, or No. 2, plant is near the village of Tariffville. At Rainbow the plant comprises a brick building with two Westinghouse generators, each belt connected to a horizontal turbine wheel. The capacity of each generator is 600 kw at 500 volts and 60 cycles, two-phase. This plant also contains four oil-cooled transformers of 300 kw capacity each, which raise the pressure of the energy from the generators to 10,000 volts and change it to three-phase. At Tariffville, the No. 2 station consists of a brick building in which are two Westinghouse generators, each direct connected to a horizontal turbine wheel. Each of these generators has a capacity of 750 kw at 500 volts, and their energy is raised to 10,000 volts, three-phase, by transformers. The combined capacity of generators in the two water power plants is thus 2700 kw. The steam power plant in Hartford, called No. 3 station, contains one 600-kw and one 400-kw generator, each driven by belt from an independent engine. The larger of these two generators delivers energy two-phase and 60-cycle at 2400 volts.

Besides the generators just named this station contains a 1500-kw alternator, direct connected to a steam turbine, all of Westinghouse make. This turbine alternator operates at 1200 r. p. m. and delivers energy at 2400 volts and 60 cycles, two-phase. With the 2500 kw of generating capacity at this steam plant, the water power stations give the system a rated dynamo output of 52000 kw at full load.

This turbine has been in actual operation long enough to sustain the statement of the builders and operators that it marks a distinct advancement in central station practice, and it may now be added that it has proved to be commercially successful. Its performance has been carefully noted under widely varying conditions, and while no official tests have yet been made, enough data have been gathered by the Hartford Company to satisfy it of the efficiency and economy of the installation.

FIG. 1.—INTERIOR OF STATION NO. 3, HARTFORD, CONN.

It might be well to mention in this connection that the Hartford plant differs materially from turbine installations that have heretofore been made, both in this country and abroad. It has also the distinction of being the largest steam turbine plant in one integral part that has ever been built. The outfit weighs 175,000 lbs., including the generator, which is directly connected to the turbine, as shown in Figs. 3 and 4, and occupies a space 33 ft. 3 inches long and 6 ft. 9 inches wide. An examination of the illustrations of this outfit reveal the fact that the design and construction have been made to conform more to American ideas than the earlier machines of the same type. The turbine is entirely automatic in all its functions and requires very little attention. There are no rubbing surfaces and,

consequently, no internal lubrication is necessary, with the consequence that super-heated steam and surface condensers may be employed to the greatest advantage. The only real working part is the spindle revolving in its bearings, and as these bearings have been designed for minimum wear, the cost of repairs and renewal should be very small.

There is nothing remarkable in the design of generator used with the turbine, the principal modifications being those necessitated by the high speed at which the turbine operates, permitting a considerable reduction in weight and size, and making it possible to obviate crowding of pole pieces.

Besides the generators just mentioned at the steam power station there are also located there two rotary converters of 400 kw capacity each, four 375-kw, four 300-kw and four 200-kw transformers. At the battery sub-station on State Street are located two 250-kw and one 300-kw rotary converters, together with transformers of equivalent capacity, also a battery with 140 cells of 17,000 ampere-hours each. Two other sub-stations at opposite sides of the city contain constant-current transformers that supply series circuits for alternating arcs.

Each of the water power plants is connected by an independent line with the steam power station in Hartford. The energy developed by the water-driven generators, after being raised from 500 to 10,000 volts, is transmitted to the four 300-kw and the four 375-kw transformers at the steam power station, and there reduced to 2400 volts. A part of this energy from the water powers is further lowered in pressure by the four 200-kw transformers at the steam station, which feed the two rotary converters of 400 kw each, there located. These rotaries deliver direct current at approximately 220 volts to an underground, three-wire system that supplies consumers throughout the main business parts of the city.

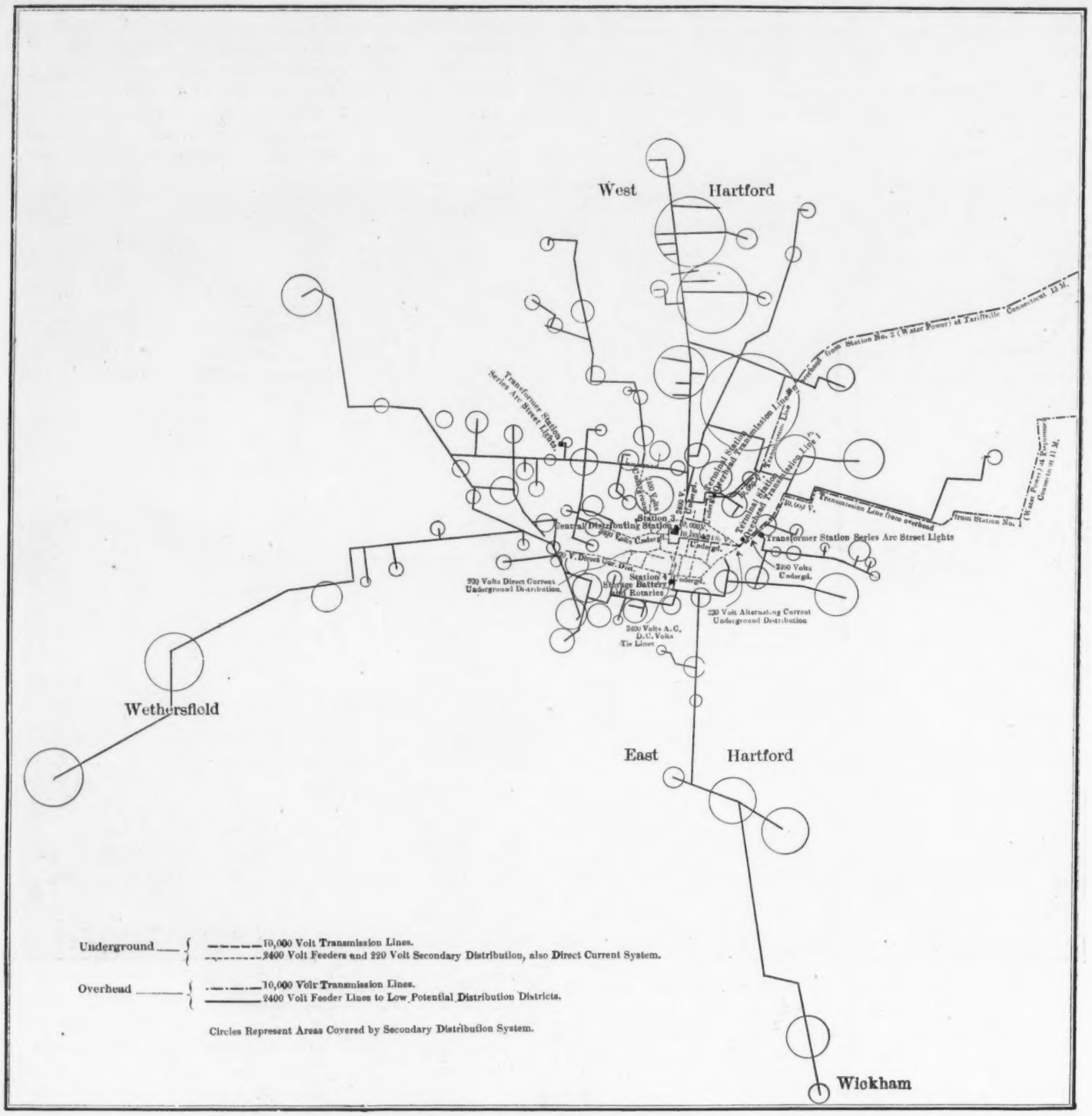

West Hartford
East Hartford
Wethersfield
Wickham
Transformer Station Series Arc Street Lights
Terminal Station Overhead Transmission Line
Transmission Line from overhead
from Station No. 1 (Water Power) at Collinsville, Connecticut 11 M.
Central Distributing Station
Station 2
Station 4
Storage Battery and Rotaries
220 Volts Direct Current Underground Distribution
220 Volt Alternating Current Underground Distribution
2400 Volts A.C., D.C. Volts Tie Lines
Underground — 10,000 Volt Transmission Lines.
2400 Volt Feeders and 220 Volt Secondary Distribution, also Direct Current System.
Overhead — 10,000 Volt Transmission Lines.
2400 Volt Feeder Lines to Low Potential Distribution Districts.
Circles Represent Areas Covered by Secondary Distribution System.

FIG. 2.—SCHEME OF FEEDERS AND DISTRIBUTION.

Two-phase current at 60 cycles and 2400 volts passes from the larger transformers at the steam station to the switchboard there, and is thence distributed to the sub-stations and the suburbs of the city for lighting and motor service. The 2400-volt current is transformed at the battery station for the rotary converters there, which

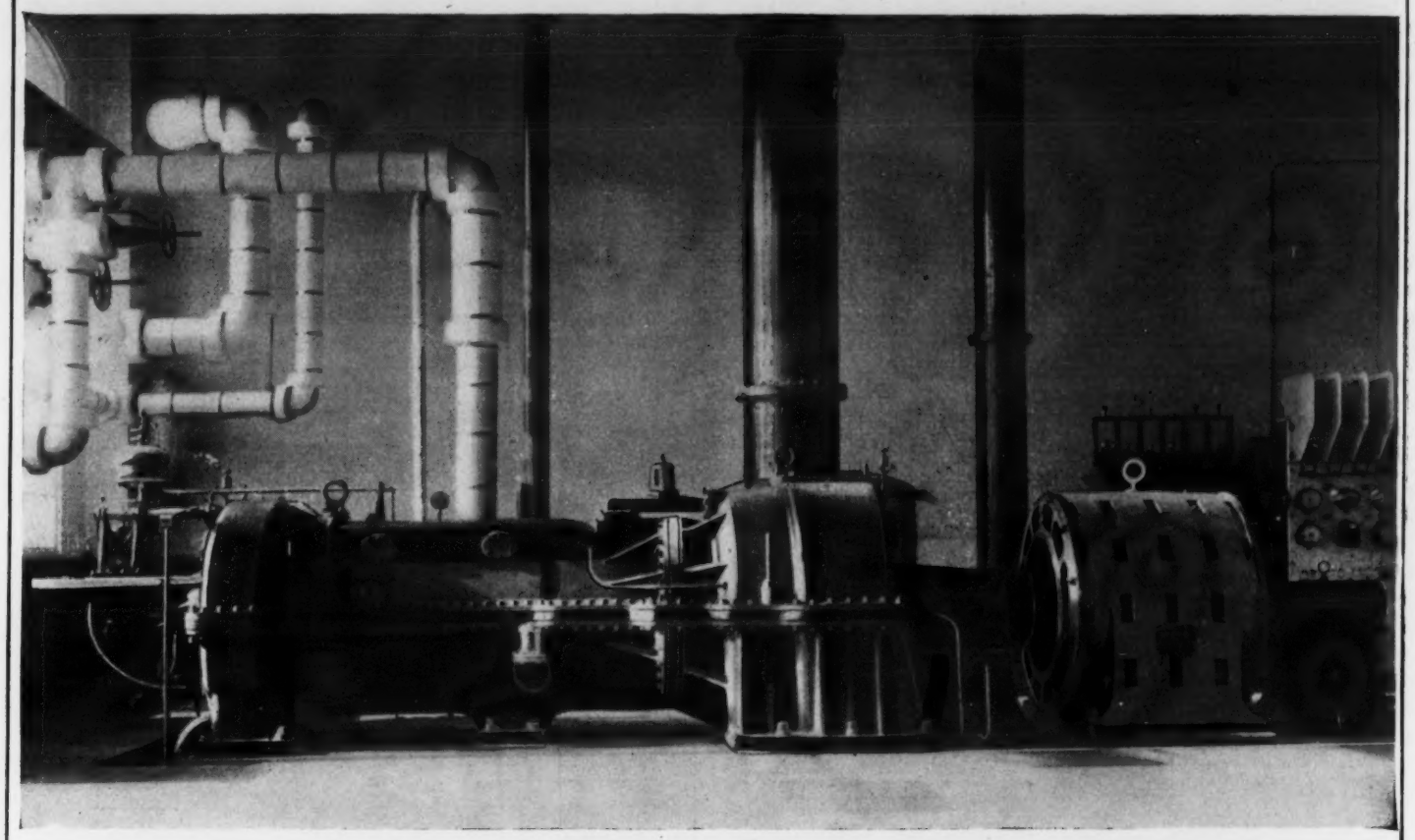


Fig. 3.—1500-kw Steam Turbine and Generator, Hartford.

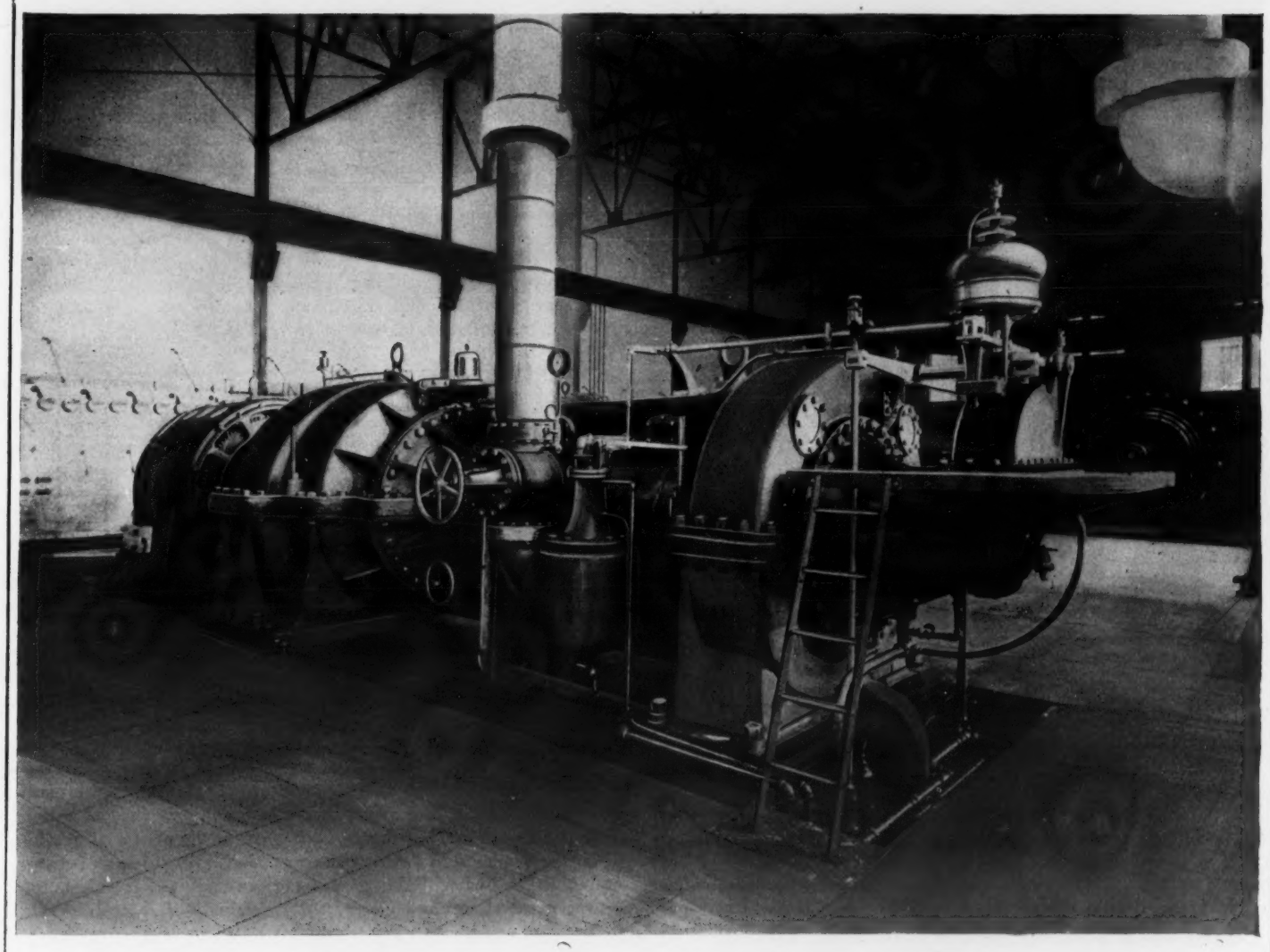


Fig. 4.—Another View of the 1500-kw Steam Turbine and Generator.

STEAM TURBINE GENERATOR, HARTFORD, CONN., PLANT.

deliver direct current at approximately 220 volts to either the batteries or the three-wire underground system previously mentioned. At the two sub-stations devoted to the supply of alternating arcs on series circuits, the 2400-volt energy from the steam power station is passed through transformers that deliver constant current of 6.25 amperes. The 600, the 400 and the 1500-kw generator at the steam station deliver their energy at 2400 volts to the same switchboard that receives the current from the transformers connected with the water power plants.

It is thus possible to combine the outputs from water power and steam so that each may carry any desired portion of the total service load. The 400-kw generator at the steam station is of the double-current type, so that it can be used with its transformers to supply

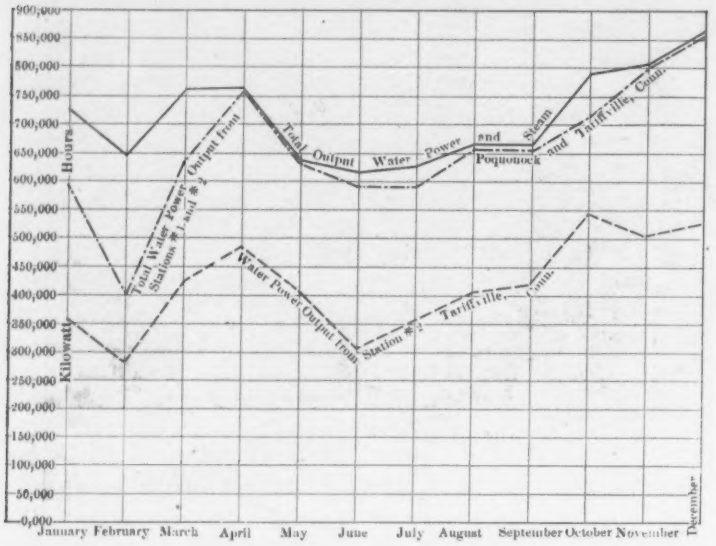

Kilowatt Hours
Total Output Water Power and Steam
Total Water Power Output from Stations #1 and #2
Water Power Output from Station #1
Pequonock and Tariffville, Conn.
Tariffville, Conn.
January February March April May June July August September October November December

FIG. 5.—ENERGY OUTPUT CURVE.

either direct current at 220 volts or 60 cycle, 2400-volt alternating current. Energy from the water powers is absorbed by the batteries during periods of small load, and the batteries discharge into the outside conductors of the three-wire system in the usual way. The load of the Hartford plants is made up of arc and incandescent lamps and motors connected to the three-wire system, the same classes of service from the 2400-volt system through transformers of constant pressure, and series arc street lamps fed from constant-current transformers, which are also connected to the 2400-volt lines. Where motors are supplied with alternating current they are of the two-phase type, the two wires of each phase being brought to the motor. Arc and incandescent lamps are supplied from independent circuits representing each phase.

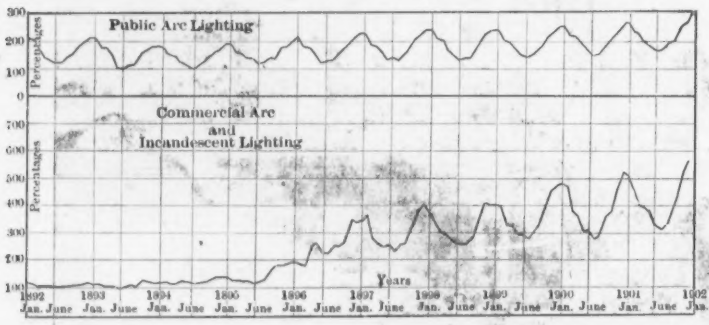


FIG. 6.—PERCENTAGE INCREASE OF RECEIPTS.

The Hartford plants are especially designed with a view to economy of both steam and water power. Too frequently systems that enjoy the advantage of water powers lack storage batteries, and thus lose large amounts of energy during the hours of small loads, which could be used to good advantage at periods of maximum demand. In this way much of the possible benefits of water power is lost.

Economy in the production of steam power at Hartford is sought by the use of the steam turbine above mentioned, by condensers with the engines, and three large cooling towers in which the water from condensers is subject to a mechanical draft of air while passing over layers of unglazed tiles. Fans for the production of this draft are driven by electric motors.

A large motor load has been secured for the Hartford system, and the battery capacity that would otherwise be necessary for the storage of energy from the water powers is thereby reduced. In October, 1901, the system had connected 68,725 incandescent and 1679 arc lamps. On Dec. 6 of the same year the number of motors supplied was 480, and their total rated horse-power 3476. This gives the unusually high average of 7.24 hp per motor, and indicates that the per cent of large motors to the total number is greater than in most cities. If these motors have an average efficiency of 74.6 per cent their kilowatt capacity is represented by the figures just given for horse-power, namely, 3476. Allowing 60 watts for each of the incandescent lamps, their total capacity amounts to 4123.5 kw. The arc lamps have a capacity of 471.6 kw, if each lamp consumes energy at the rate of 400 watts on an average.

The total of these figures is 8271 kw for the entire connected load. Of this total, motors make up the unusually large portion of 40.5

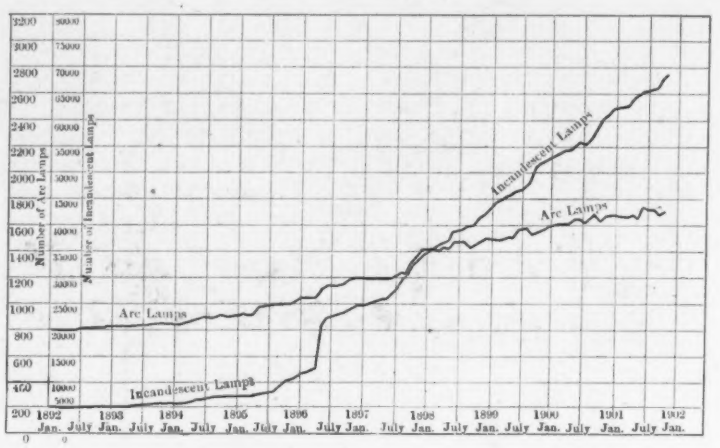

Number of Arc Lamps
Number of Incandescent Lamps
Arc Lamps
Incandescent Lamps
1892 1893 1894 1895 1896 1897 1898 1899 1900 1901 1902

FIG. 7.—INCREASE IN LIGHTING SINCE 1892.

per cent. On Jan. 1, 1902, the numbers of arc lamps devoted to street lighting was 872, and 753 of these were on constant-current alternating circuits. Figures for a week-day load in several months of 1901 bring out some interesting relations between maximum, minimum, average and connected load, and the use of storage batteries in the system. On a week-day in January, 1901, the maximum load was 2720 kw, and the total energy output was 30,249 kw-hours. The average load for each of the 24 hours was, therefore, 1260 kw, or 46 per cent of the maximum load. On this same day the battery discharged at the rate of 260 kw at the peak of the load. In the early morning hours of this day the load on the system, apart from battery charging reached its minimum at 612 kw, or only 22.5 per cent of the maximum load.

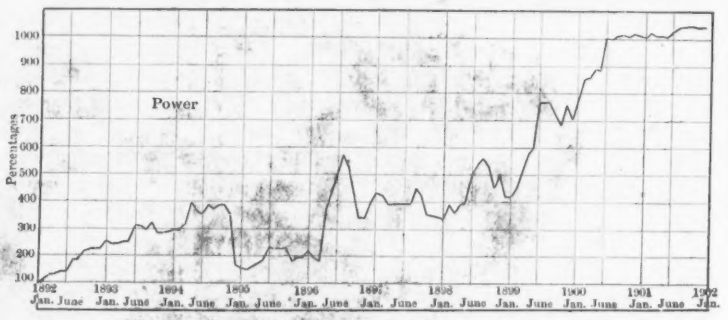


FIG. 8.—PERCENTAGE INCREASE OF RECEIPTS.

In July, 1901, the minimum load on a certain week day was 1390 kw, and the minimum load 250 kw, or 18 per cent of the former. The total output on this day was 25,105 kw-hours, so that the average load during the 24 hours was 1046 kw, or 75 per cent of the maximum load. For the day in question the maximum rate of battery discharge was 150 kw, but this did not occur at the period of greatest load on the system. In January the maximum load came on between 4 and 5 P. M., when lighting was the predominant factor, but in July the greatest demand on the system came in the latter part of the forenoon, and must have been made up in large part by requirements for electric power. By December, 1901, the maximum load reached 2838 kw, and the minimum load was 612 kw. The

greatest rate of battery discharge for the December day was 350 kw. In the month just named there were connected to the system 72,085 incandescent and 1824 arc lamps. Allowing 60 watts for the capacity of each incandescent and 400 watts for each arc, the total capacity of the former was 43,251 and of the latter 7296 kw. Adding these numbers to the 3476 kw of motor capacity found for Dec. 6, shows the approximate capacity of all connected lamps and motors in that month to have been 8530 kw. The maximum load of 2838 kw for the December day is only 33 per cent of the connected capacity just found. On this day the total output was 32,191 kw-hours, so that the average load during the 24 hours was 1342 kw. This average is 15 per cent of the total capacity of connected lamps and motors.

Extensive use of water power and its economical methods of distribution have contributed to effective competition on the part of the Hartford electric system. The price of gas in Hartford has been moderate for some years, and stood at $1 per 1000 cu. ft. in 1901. In spite of this fact electrical supply from the Hartford system has increased at an exceptionally rapid rate. In January, 1892, the public arc lamps supplied numbered 476, and 10 years later, in December, 1901, this number had increased to 853, or to 179 per cent of that in the earlier year. As is well known, street lighting offers much less opportunity for possible expansion than does commercial service. In January, 1892, the commercial arcs connected to the system numbered 308, and in December, 1901, the number was 971, or 315 per cent of that 10 years previous. Even commercial arc lighting has not the inherent capacity for expansion found in incandescent and

Numbers of arc and incandescent lamps connected to the system in January of each year.

Year.	Number of public arcs.	Number commercial arcs.	Number commercial incandescent.
1892.....	476	308	4,851
1893.....	494	312	4,879
1894.....	504	325	5,603
1895.....	537	380	7,070
1896.....	607	430	11,606
1897.....	642	547	26,671
1898.....	692	719	34,751
1899.....	730	768	42,938
1900.....	784	828	52,985
1901.....	841	832	62,222
December, 1901.....	853	971	72,085

Prior to 1898 the number of public exceeded that of commercial arcs, but in that year commercial arcs shot ahead. The income from public arc lamps in the month of December, 1901, was greater by 42.3 per cent than the like income for the month of January, 1892. Commercial arc and incandescent lamps yielded an income in December, 1901, that was 5.035 times the like income in January, 1892. As to the income from sales of electric motive power in the month last named, the receipts from the same sort of service during De-

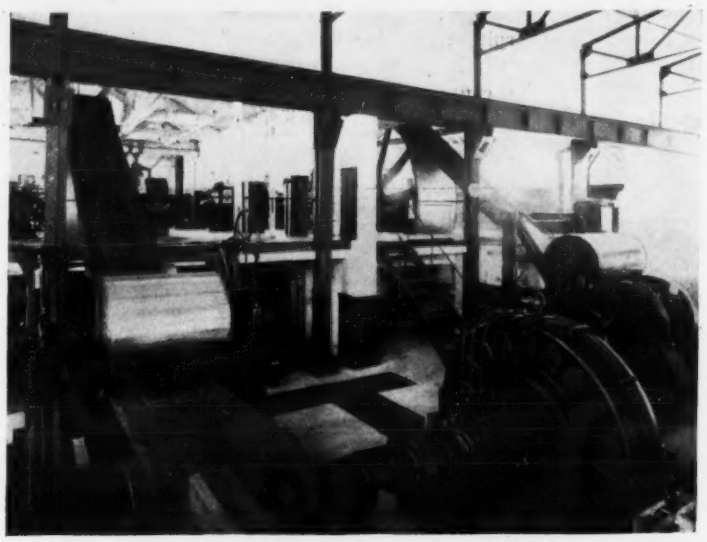


FIG. 9.—400 AND 600-KW GENERATORS.

FIG. 10.—SUB-STATION, BELDEN STREET.

power service. This is well illustrated by the case in hand. The Hartford system was operating 4851 incandescent lamps in January, 1892, and in December, 1901, the number of these lamps was 72,085, or 14.8 times that for the earlier year. From the foregoing it seems that the average yearly gain during the decade for arc street lamps was 7.9 per cent, for commercial arcs 31.5 per cent, and for incandescent lamps 148 per cent of the number connected to the system in January, 1892.

The moderate gains in the numbers of arc lamps have been made at a much more nearly uniform rate than that by which incandescent service has advanced. In January, 1896, the number of incandescent lamps connected to the system was 11,606, a gain of 139 per cent over the 4851 so connected in January, 1892. This gain during four years amounts to 34.7 per cent yearly of the number in 1892. From January, 1896, to December, 1901, the incandescent lamps added to the system were 1246 per cent of the number of these lamps in January, 1892. This addition amounts to an average yearly increase of 207 per cent of the number of incandescent lamps in the earliest year named. Unfortunately, it is not possible to present figures for the horse-power of motors connected to the Hartford system during the period under consideration. Other facts are at hand, however, which show that the rate of increase for electric power service was greater than that in either of the other lines.

Second only to the expansion of electrical supply from the Hartford plants has been the rise of their incomes. These incomes are here considered as to public arc lighting, commercial arc and incandescent lighting, and electric power.

cember, 1901, showed a gain of 945 per cent. The average yearly gain during the decade was thus 4.2 per cent for income from public arcs, 40.3 per cent for commercial lighting income, and 94.5 per cent for income from electric motive power, in the December months.

Water power has evidently been the most important physical factor in the rapid development of the Hartford electric system. During the entire period under consideration water power has supplied a very large though varying portion of the total energy output of the plants. Water power station No. 1, above described, was put into operation during November, 1891. The second water power, at No. 2 station, began to supply electrical energy in November, 1899.

Since the second water power station was started, only a small fraction of the delivered energy has been generated from coal, except at those times of year when the supply of water has been too small to meet the full demand. Fortunately, owing to the excellent engineering practiced by the company and the liberal policy of its management, it is possible to give the figures for the energy derived from water power, and the total output of the system in kw-hours. These figures are here presented for the kw-hours from water power, and for the entire output during each month of 1901. Considering the entire year, the energy output of the system was 8,577,699 kw-hours, and of this only 1,009,598 kw-hours were developed with steam power. It follows that the output from water power was 88.2 per cent of the total energy. If the available water power had remained constant at its higher values, little work would have been required of the steam equipment at any period of the year, and it is instructive to consider the records of the several months.

Energy output from water and steam power during the months of 1901.

Month.	Total kw-hours of output.	Kw-hours from water.	Kw-hours from steam.	Per cent of total from water.
January	748,096	588,100	159,996	78.6
February	642,762	292,500	350,262	45.5
March	758,537	633,400	125,137	83.5
April	760,531	615,900	144,631	80.9
May	635,421	630,800	4,621	99.2
June	616,407	583,900	32,507	94.7
July	625,530	589,800	35,730	94.2
August	666,898	656,500	10,398	98.4
September	660,213	654,000	6,213	99.0
October	790,521	665,600	124,921	84.1
November	805,837	804,901	936	99.8
December	866,946	852,700	14,246	98.4

The lowest ratio of output from water to the total electrical output for the month was that in February, when the water plants supplied only 45.5 per cent of the total energy, and the steam plant delivered 350,262 kw-hours. In November, on the other hand, 99.8 per cent of the total output from the system was developed by water power, and the steam plant supplied only 936 kw-hours.

During each of five months in 1901 more than 98 per cent of the total energy output was from water, yet in one month the steam plant was required to develop 54.5 per cent of the total energy. The largest monthly output from the steam plant, 350,262 kw-hours, was 4.16 times as great as the average monthly output of 84,133 kw-hours from steam power.

water power in the Hartford system, also illustrate the most inherent weakness, of such power, namely, the necessity of a relatively large steam plant that must be mostly idle during the greater part of the year. It is a most important consideration, however, that this requirement for steam plant is inherent in electric, water power systems as they usually are, rather than as they may be. Thus far

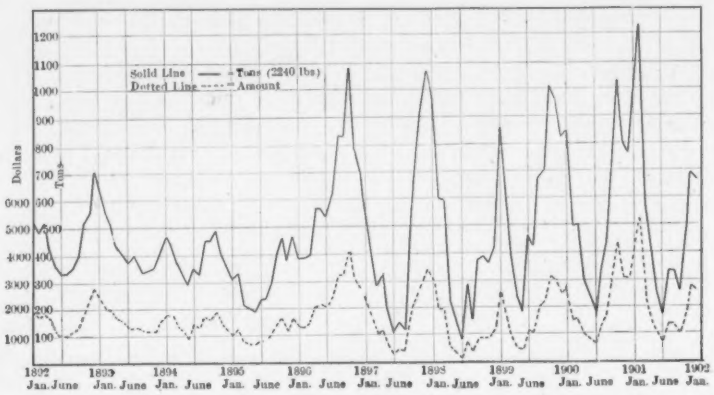


FIG. 12.—TONS CONSUMED AND AMOUNT PAID FOR COAL PER MONTH.

comparatively little has been done in the storage of water for systems of electrical supply. When this subject receives the attention it deserves, the surplus water that now runs freely to the ocean during some months of the year, will be impounded and later put to useful work in the scanty seasons.

The great advantage of water power to the Hartford Electric

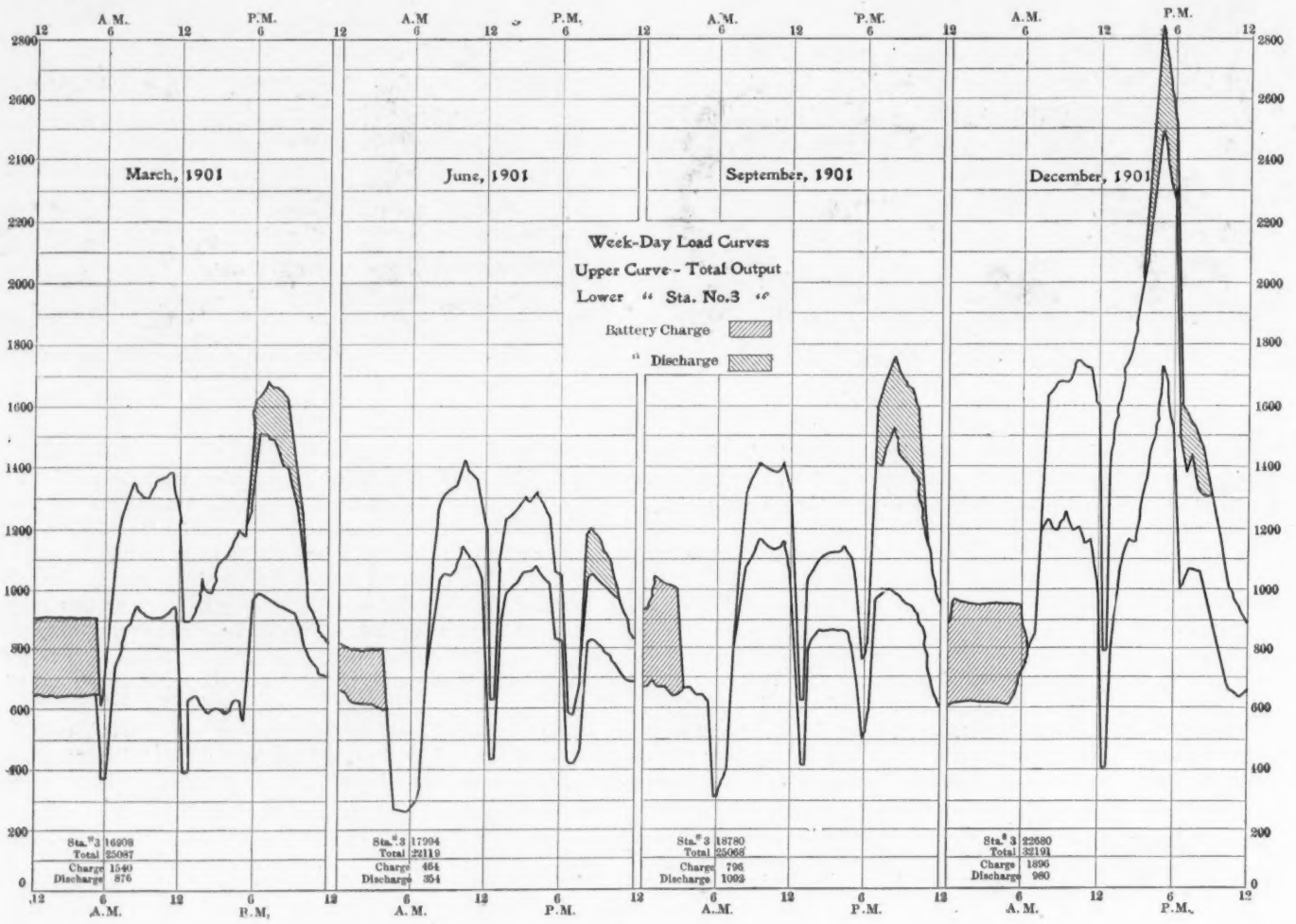


FIG. 11.—WEEK-DAY LOAD CURVES.

The greatest development of energy by water in any month was that in December of 852,700 kw-hours, and the least monthly development from this source was 292,500 kw-hours during February. This maximum output is 2.9 times the minimum, and 1.3 times the average monthly figure of 630,675 kw-hours from water power. These facts, while they bring out the very important position of Light Company, and the important part it occupies in their system is further illustrated by figures for the tons of coal yearly consumed at their stations. To fully appreciate the force of these figures it is necessary to hold in mind that a large, though indeterminate, part of the coal yearly consumed is devoted to the public supply of steam heat, so that much coal is consumed when the output from water

power is at its highest point. An illustration of this may be seen in November, 1901, when the electrical energy delivered by the steam plant was only 936 kw-hours, but the coal consumption of the system amounted to 691 tons. So great has been the preponderance of water over steam power in the system that the increase above noted in connected electrical loads has had only a comparatively slight effect on the yearly amounts of coal consumed. This is well illustrated by figures for the years of 1892 and 1901 as to coal supply.

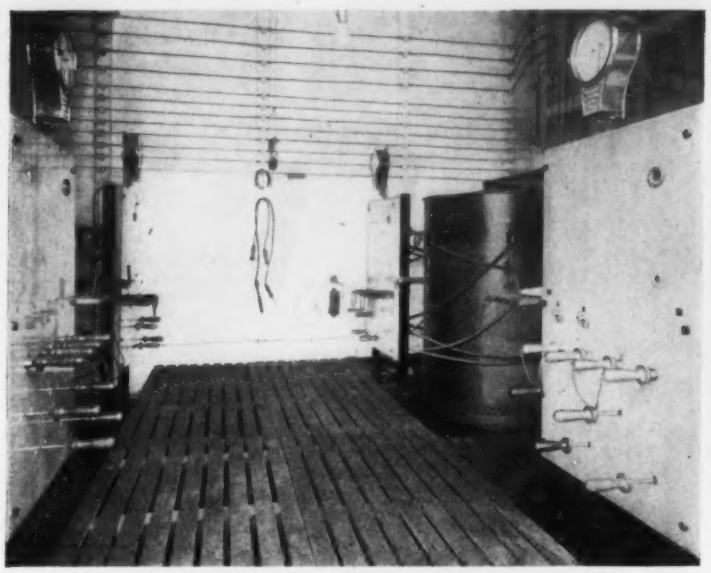


FIG. 13.—INTERIOR OF SUB-STATION, WARD STREET.

In the earlier year the system consumed 5496.72 tons, and in the later 6306.4 tons of coal for all purposes.

Tons of coal consumed by the Hartford system during each year.

Year.	Tons of coal.	Year.	Tons of coal.
1892.....	5,496.72	1897.....	5,363.42
1893.....	5,120.86	1898.....	4,628.79
1894.....	4,634.16	1899.....	7,394.95
1895.....	3,727.56	1900.....	6,652.69
1896.....	7,711.18	1901.....	6,306.40

It thus appears that the consumption of coal was only 15 per cent greater in 1901 than in 1892. Meantime, however, as has already been

FIG. 14.—LIGHTNING ARRESTER IN TERMINAL HOUSE.

shown, the gain in income from public arc lamps was 42.3 per cent, from commercial arcs and incandescent lamps 403.5 per cent, and from electric motive power 945 per cent of the corresponding amounts in 1892.

The growth of electrical supply cannot be accurately measured by the capacity of connected lamps and motors, because the average yearly use of each connected unit has generally declined. Neither can money income serve as an accurate measure of electrical service, because, as a rule, prices have declined.

It is, therefore, of much interest in the present case to illustrate the expansion of the Hartford system by the figures for actual energy output. These figures are not available for the entire decade, but it is possible to present them for the last seven months of 1898 in comparison with the like months of 1901. The 616,407 kw-hours sent out by the Hartford system during June, 1901, were greater by 76

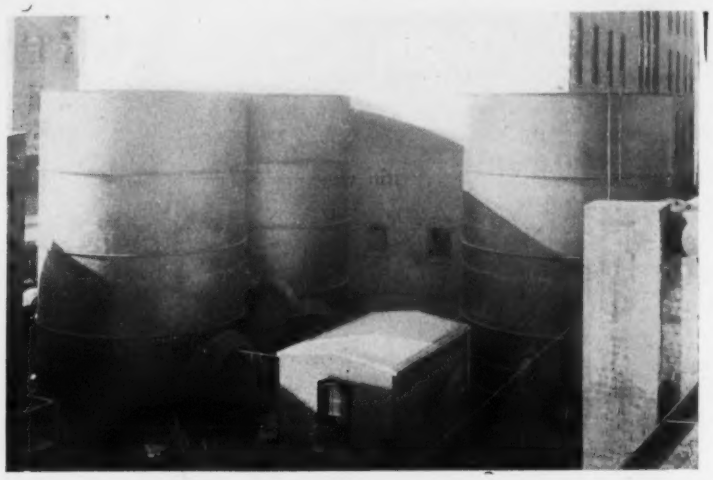


FIG. 15.—COOLING TOWERS FOR TURBINE, STATION NO. 3.

per cent than the output of 348,700 kw-hours during the corresponding month of 1898. In September, 1901, the kw-hours of output exceeded the output during the same month of the earlier year by 87 per cent. For the remaining months considered, the ratios of increase over the outputs in the earlier year range between the figures just given.

The fact that 88.2 per cent of the total energy output of the Hartford system, during the year 1901, was developed by water, in spite of the requirement of steam for 54.5 per cent of the total energy in a single month, carries its obvious lesson as to the value of water

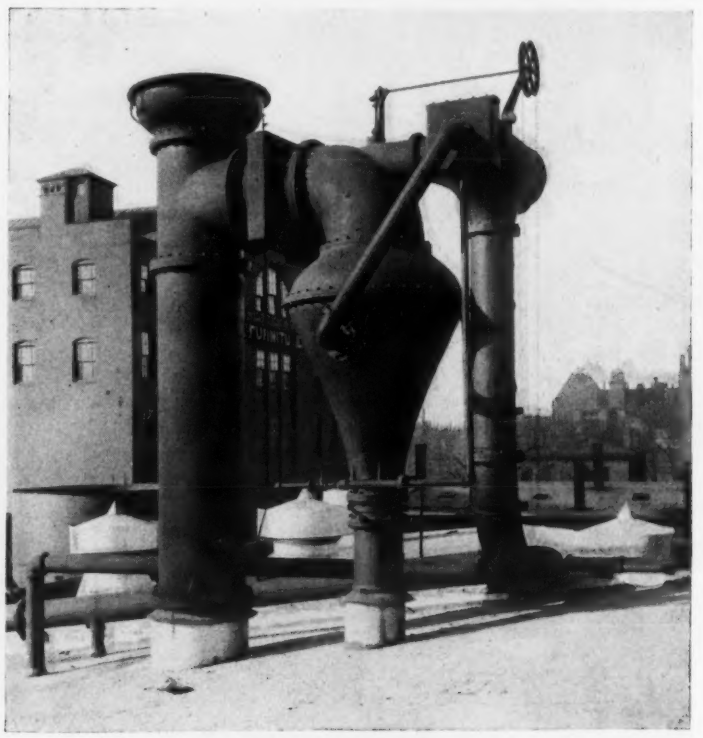


FIG. 16.—JET CONDENSER, STATION NO. 3.

power in a system of electrical supply. This lesson is made plainer by the exceptional rate of development that has been maintained for electrical supply in Hartford, in spite of the active competition of a previously existing gas company with ample physical and financial equipment. At equal prices for similar service there can be little question as to the choice of the public between gas and electrical supply. Water powers are to-day much the most important of the

known factors by which the costs of electrical energy may be reduced.

Kilowatt-hours of output by months in 1898 and 1901.

Month.	1898, kw-hours.	1901. kw-hours.	Ratio energy in 1901 to that in 1898. Per cent.
May	355,522	635,421	178
June	348,700	616,407	176
July	335,724	625,530	186
August	373,019	666,898	178
September	352,196	660,213	187
October	424,151	790,521	186
November	433,363	805,837	185
December	491,301	866,946	176

Thanks are due to Mr. Austin C. Dunham, president; Mr. Robert W. Rollins, general manager, and to other officers of the Hartford Electric Light Company for the facts which their liberal policy has made it possible to set out in this article.

It is to be hoped, for the general good of electrical supply, that the precedent here set, as to publication of figures for actual energy outputs, will be followed for other systems. In this way a body of data of great value may be built up for American stations, similar to that already existing in England and on the Continent of Europe.

District Electrical Supply.

For some years past a practice has grown up on the Continent of Europe whereby, instead of there being a number of separate central stations in near-by towns, a large central generating plant furnishes the energy for all of the towns within a considerable territory. With the voltages now practicable, it is entirely feasible to supply in this manner a large territory, and one of the developments to be expected in the near future is a considerable extension of this practice in this country, involving in many cases the consolidation of the companies operating plants in neighboring towns.

An example of such a central plant is one recently erected by the Central Electric Company at Metuchen, N. J., for the supply of current to Metuchen, Highland Park, New Brunswick, Perth Amboy, Rahway, Woodbridge, Bound Brook and Dunellen. This company is a consolidation of the Middlesex Electric Company, Edison Electric Illuminating Company of New Brunswick, Raritan Electric

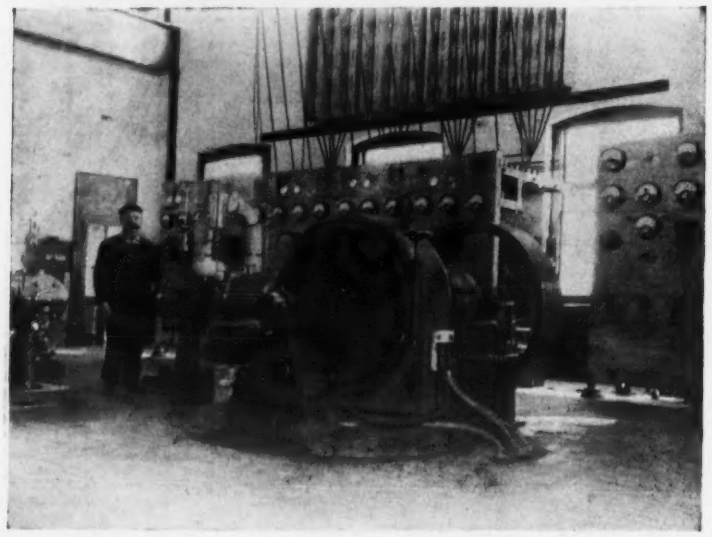


FIG. 1.—METUCHEN PLANT.

Light & Power Company, of Perth Amboy; Rahway Electric Company, of Rahway, and Bound Brook Electric Light, Heat & Power Company, of Bound Brook.

The equipment of the generating stations replaced by the new central plant was as follows: Edison Electric Illuminating Company at New Brunswick, Edison bipolar machines belted from countershaft driven by belt from simple Corliss type engines. The Raritan Electric Light & Power Company's plant at Perth Amboy was equipped with 1100-volt single-phase alternators and American arc machines belted from a countershaft driven by belt from a simple high-speed engines. The apparatus at the Rahway Electric Company's plant at Rahway consisted of single-phase, 2200-volt, 125-cycle alternators and 500-volt railway generators, all belted from high-speed engines. The Bound Brook Electric Light & Power Company at Bound Brook was operating an 1100-volt, two-phase alternator, belt-driven from a Corliss engine. The location of all of these plants made it necessary to cart all coal used at a cost of 28 to 40 cents per ton, and in every case except at Bound Brook, to purchase water for boiler supply.

The main units in the engine room are two horizontal cross com-

FIG. 2.—PERTH AMBOY SUB-STATION.

pound condensing engines, having cylinders 24 by 44 by 42, supplied by the Pennsylvania Iron Works Company, direct connected to 500-kw, three-phase, 60-cycle, 6600-volt Stanley generators. These engines are of the heavy duty railway type, having flywheels weighing 47 tons.

Steam is generated in two vertical water-tube boilers, supplied by the Clonbrook Steam Boiler Company, of 600 hp each, or of a capacity to evaporate 18,000 lbs. of water per hour into dry steam. Each boiler has a stack 60 inches in diameter by 75 ft. high, erected on the top of the boiler casing. There is a reserve space in the boiler room for a third similar unit, the foundation for which is already down.

The boiler water supply may be had from any one of the three sources—a spring-fed brook, three artesian wells about 100 ft. deep, and the regular city water works system. Water is first pumped into a large tank near the roof, which supplies a 1250-hp Webster vacuum feed water heater, and from the heater is pumped directly into the boilers. Either of the pumps may be used to feed the boilers or discharge into the tank, as the piping is in duplicate to the boilers. Coal is carried into the station from a siding of the Lehigh Valley Railroad up a trestle to a track over the coal storage space, which discharges close to the furnace doors. The engines are equipped with special piping which makes it possible in case of accident to one side, to operate the other either condensing or non-condensing, which greatly reduces the chances of a complete shut down. Two 50-kw, 125-volt Westinghouse generators are installed as exciters, each direct connected to a Ball & Wood tandem compound engine.

The engines are supplied with a complete oiling system, whereby all of the waste oil is brought to a central point and discharged into

an oil filter, which in turn discharges into a tank, from which the oil is pumped again into the receiving tank of the system.

The condenser is of the elevated central condensing type, supplied by Henry R. Worthington, who also supplied the compound circulating pump and the rotative dry vacuum pump. Condensing water is obtained from three brooks, which supply an artificial lake, and to which lake the discharge from hot well may be returned in case of scarcity of water. The piping is also arranged that water may be drawn from three artesian wells for condensing purposes, and although this source would not be sufficient in itself, the low temperature of the water obtained from these wells considerably reduces the surface water required.

The generators supply alternating current at the transmission pressure of 6600 volts. All of the high-tension switches on the switchboard, which was supplied by the Stanley Company, are of the oil type and of double the carrying capacity required for either the generators or circuits. The main switchboard now consists of two main generator panels and five circuit panels. The mains from one of the circuit panels lead to another part of the building to a set of Stanley three to two-phase step-down transformers having a ratio of 6600 to 2300 two-phase, at which pressure the current is distributed for local lighting. The high-tension leads from the other four panels are carried through lightning protection devices to sub-stations at New Brunswick, Perth Amboy, Rahway and Lincoln, which latter supplies the Bound Brook district. General Electric short-gap arresters with Stanley dischargers are used on all feeders.

The line is of the most substantial construction throughout, the insulators used being 10,000-volt Hemingray glass. The feeders vary in length from 4½ to 9½ miles, and are given two transpositions at respectively one-third and two-thirds of the distance covered by each particular feeder. All feeders are carried overhead their entire distance, except those to New Brunswick, which are carried on the stonework of a bridge over the Raritan River, then down through a triple-conductor, steel-armored submarine Okonite cable under the Delaware & Raritan Canal, which parallels the Raritan River at this point. On the opposite bank of the canal the line is carried underground through Okonite single-conductor lead-covered cable, each drawn in a separate conduit to the sub-station about 550 ft. distant. The whole underground and underwater system is provided with oil switches and is in duplicate, thus making it possible to carry the whole load on either set entirely independent of the other in case of accident.

The present installation of the New Brunswick sub-station includes one 100-kw set of step-down transformers for lighting, and one 200-kw, 240-volt Westinghouse rotary converter for supplying the Edison three-wire system, space, however, being reserved for double this equipment, which will probably be required in the very near future.

At the Perth Amboy sub-station there are at present installed two 100-kw Stanley step-down transformers, 6000-volt three-phase, to 2300 volts two-phase; and three General Electric constant-current transformers for street lighting, each having capacity of 50 6.6-ampere enclosed arc lamps, the primaries of which will take the current directly from the three-phase transmission, working three to two-phase, or straight single-phase, as desired. The three transformers now installed are connected in single-phase, but with the addition of the fourth one, the three to two-phase connection will be used, thereby obtaining a balance of the transmission independent of the number of transformers installed.

The equipment of the Rahway sub-station is similar to the one at Perth Amboy, but lacking the constant-current transformers, and with the addition of one 200-kw Westinghouse rotary converter, 550 volts, supplying current to the street railway company.

The present installation at the Lincoln sub-station comprises one 100-kw set of Stanley step-down transformers similar to the others, and three reactive-coil General Electric series regulators for the incandescent street lighting system.

The main generating plant at Metuchen was designed, as a whole, by Mr. Paul C. Oscanyan. The operating force of the company consists of Dudley Farrand, general manager; H. C. Richardson, general superintendent; S. D. Sprong, chief engineer; W. A. Belcher, superintendent Perth Amboy & Rahway divisions; R. P. Bache, superintendent Bound Brook division.

Canadian Electrical Association.

The Canadian Electrical Association will hold its next annual convention at Quebec on June 11, 12 and 13.

Progress on the Illinois Telephone and Telegraph Tunnel in Chicago.

One of the most daring financial and engineering undertakings of the decade is the underground tunnel system now being constructed under Chicago's principal business streets by the Illinois Telephone &

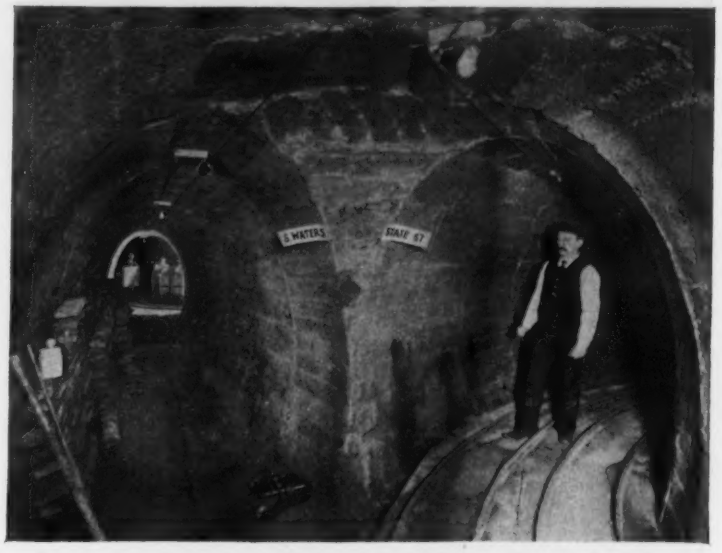


FIG. 1.—INTERSECTION SOUTH WATER AND STATE STREETS.

Telegraph Company, a corporation whose officers promise within a short time to give Chicago an independent telephone exchange in opposition to the Chicago Telephone Company. This tunnel, which is to serve the purpose of a conduit for wires, has already been excavated under more than 6 miles of streets, and it is expected to put it

FIG. 2.—ONE OF THE SHAFT HOUSES.

under every street in the city where underground telephone wires will be needed. Trunk tunnels with branches will be run out from the business center to the various sides of the city. The tunnels are 40 ft. below the surface, and of concrete arch construction, as shown by

the accompanying photographs. The main or trunk tunnels are 14 ft. high and 12 ft. wide. The lateral or branch tunnels are 8 ft. high and 6 ft. wide. This gives sufficient room to not only hold all the telephone wires of the company and underground wires of other companies, but to provide for the operation of cars through the tunnel for hauling mails and handling freight. The first object, however, is to provide ample facilities for running underground wires for the new telephone service. All of the work has been done without interfering with the surface of the street. Shaft houses like the one shown in the accompanying illustration can be found at various places on the streets, and but for these and the loads of blue clay which come up through them to the surface there is no evidence on the surface that such extensive underground work is being carried on. In starting the work, entrance to the underground system was made through the shaft houses, and in some cases through basements. At the present time, however, work has advanced far enough so that instead of bringing dirt to the surface through the shaft houses and teaming it away from there, it is all hauled in dump cars by mules through the tunnel to the opening on the river at Congress Street, illustrated herewith. There it is dumped onto scows and towed away down the river. Compressed air pressure of 7 lbs. is kept on the tunnel during excavation. After the cement grouting has been put in 12 inches thick an air pressure of 24 lbs. is put on. At street intersections, one of which is shown, steel girders are put in to carry the weight. The intersections are arranged to permit the passage of cars or wires in any direction. It is stated that over $3,000,000 has been expended on tunnels and other work, with $7,000,000 more yet to go in.

FIG. 3.—TUNNEL ENTRANCE CONGRESS STREET AND RIVER.

The president of the Illinois Telephone & Telegraph Company is A. G. Wheeler, best known in the electrical field through his prominent connection with early underground trolley work. The company is backed by C. D. Simpson and F. H. Watkins, of Scranton, Pa.; J. B. Russell, of Wilkesbarre, Pa., and C. B. Eddy, of Almagordo, N. M. This is the Simpson-Watkins syndicate which has extensive fuel and railroad interests in Colorado and New Mexico, and in the anthracite coal region of Pennsylvania. J. B. Russel & Co. are fiscal agents of the company. All of the operations of the company have been carried on in an unostentatious manner, and little has been known of the work in financial or engineering circles, but it surpasses in magnitude of conception anything of a similar nature ever undertaken. Much criticism has, of course, been offered, but the officers of the company are confident that they are working on the right lines. If the plans all work out as contemplated, it will cause a general revolution of present ideas as to the limitations of telephone service.

This company, through its officers, controls the patents of the Strowger automatic telephone exchange switchboard, and expects to use the Strowger automatic system in the mammoth Chicago exchange. Work on the apparatus for this exchange is now in progress in the Chicago factory of the Strowger Company. It is announced that a telephone instrument will be placed in every responsible business office, and that charges will be made on a meter basis of 5 cents a call, except that all calls in excess of $85 a year will be free, making the maximum possible yearly rate $85. The progress of the company with its great undertaking along radical lines is, of course, being watched with the keenest interest not only in Chicago but by telephonists throughout the entire country.

FIG. 4.—STREET INTERSECTION OF TUNNEL.

The Heany Enclosed Arc Lamp.

BY E. TRIER.

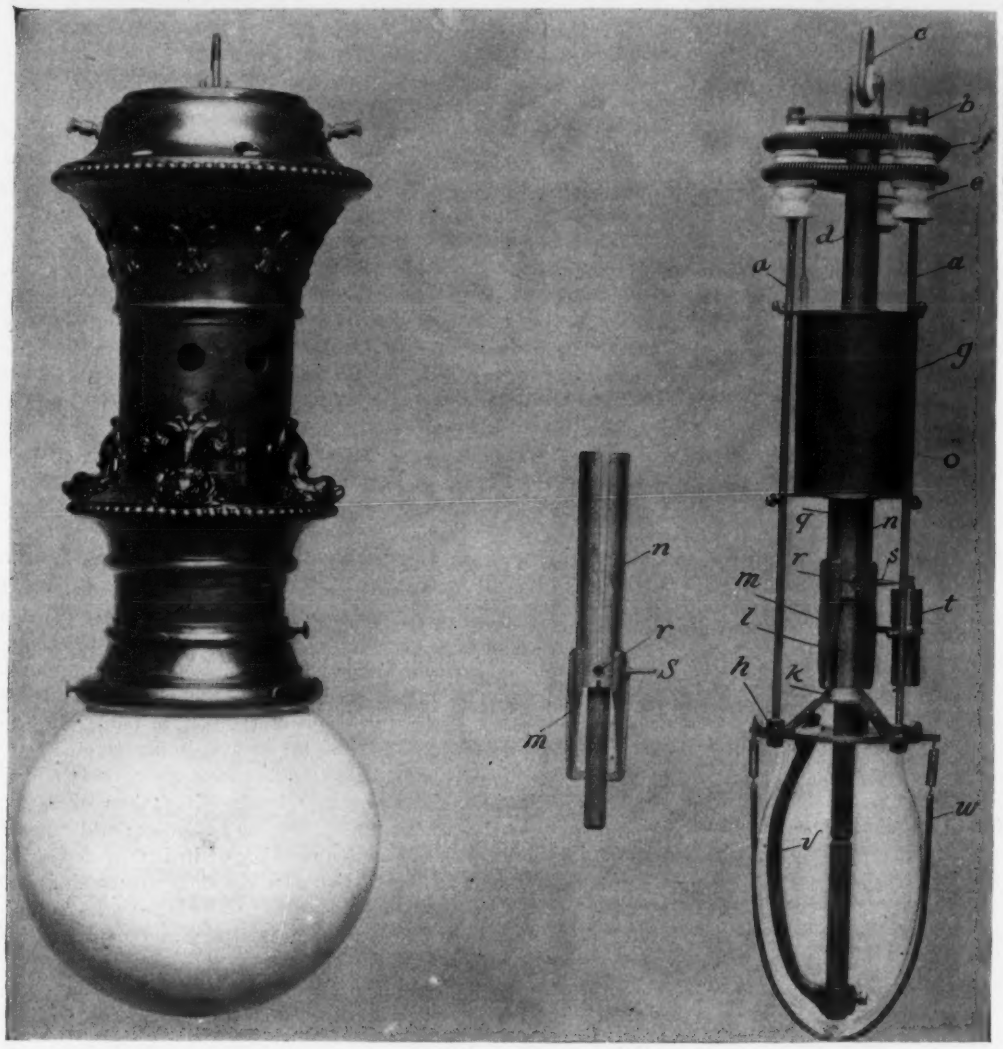
WHEN about 10 years ago a now prominent figure in the electrical profession made the prophesy that if inventors of arc lamps and arc lamp accessories would continue to work as diligently and prolifically as they did at that time, the United States Government would be compelled to either erect a separate structure or add another story to the present Patent Office Building for the accommodation of their products, most of his hearers considered the jest an unwarranted condemnation of conscientious efforts. This view has fortunately been borne out by later events, for in spite of the fact that arc lamp inventors have been accelerating their rate of production, space has always been found in the old Patent Office Building for the storage of their manuscripts and models. In obedience to the natural law of the survival of the fittest, seven distinct species have finally survived, the enclosed series and multiple lamps having within recent years largely replaced the open-arc lamps on direct as well as alternating circuits. In the words of Mr. Alton D. Adams, in a recent article on "Changes in Arc Lighting." "The several classes of arc lamps have come upon the scene one after another, and the effect of each type in displacing previous sorts has been due much more to possible economies of operation than to capacities for superior service, though this latter has not been lacking."

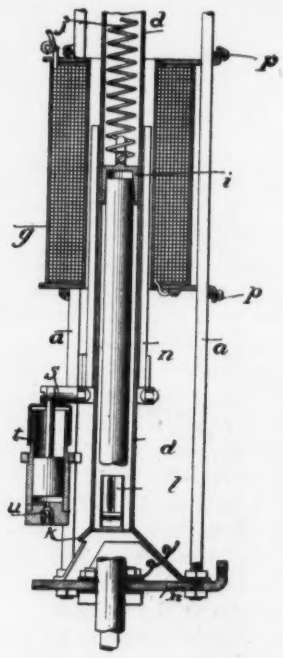
That such is the case is exemplified very forcibly by the lamp described below, which combines with economy of operation and capacity for superior service, simplicity of construction, low cost and small size. This lamp, which has successfully stood the severest commercial tests, and merits the praise which has been bestowed upon it on all sides, is the invention of J. Allen Heany, a young electrical engineer of Philadelphia.

Referring to the illustrations (Figs. 1 and 4), of this "wheelless" lamp, for there is not a single wheel in its mechanism, the supporting frame consists of three rods *a*. These rods are fastened at the top of the lamp to a stamped piece of brass *b*, which carries the hanger *c* and the brass tube *d*, containing the upper carbon. The rods also carry the porcelain knobs *e* supporting the resistance coil *f*, and after passing through the top and bottom plates of the solenoid coil *g* they are securely fastened to the base piece *h*. The brass tube *b* which contains the upper carbon holder *i*, the upper carbon and the flexible carbon holder contact *j* is secured to a conical cup *k* near the base of the lamp. The tube at its lower portion contains two slots *l* for the reception of the gripping jaws *m* of the clutch *q*, which close in on the upper carbon, and also serve the purpose of maintaining the core and clutch portion of the lamp in perfect alignment with the main portion of the lamp.

The solenoid coil *g* is wound with about ¾ lb. of No. 16 bare wire with asbestos cord between each two adjoining wires, and a sheet of asbestos between two successive layers. This makes it possible to short circuit the lamp and keep it in this condition for an indefinite period without fear of burning out the coil. In fact, damage could only be done to the coil by sending enough current through it to melt the wire. Around the coil is placed a shell of soft iron *o*, the object of which is to collect the stray magnetic lines and concentrate them within a limited, useful zone. The coil is secured to the rods *a* by means of screws *p*, so that it can be moved up and down, according to the length of arc desired.

Surrounding the inner tube *d* and within the space between it and the solenoid, operates the magnetic clutch and core *q*, shown in detail in Fig. 2. It consists of two semi-circular iron members *n* hinged together at *r*, with two jaws *m* at the lower ends, which operate within the slots *l* of the inner tube *d* and grip the upper carbon whenever the coil is energized. This makes like poles of the pieces *n*, which naturally repel each other, giving a very positive and powerful action. The energized coil tends to center the core, and in doing this raises the same somewhat, which establishes the arc. As will be seen, the lower portion of the jaws *m* are tapered, so that when they fall on the tapered piece *k* the carbon is immediately released and permitted to feed. A possible sticking action is thus prevented. Connected to the lug *s*, fastened to one of the jaws, is the dashpot *l*, which is so constructed as to cushion the upward movement of the core, without in any way hampering its downward movement. The details of this clutch, which responds to the slightest variation in the structure of the carbons and assures a very sensitive regulation, is best seen in Fig. 4, where the small sphere *u* acting as a valve is clearly shown.





FIGS. 1, 2, 3 AND 4.—ENCLOSED ARC LAMP.

To the base *h* of the lamp is connected the lower or negative carbon holder *v* and the simple globe support *w*, which consists merely of a wire supported by springs and having a loop at the bottom for the support of the inner globe. To more clearly comprehend the working of the lamp, it may be well to describe its action while in service. To assist in this we will first refer to the diagram of connections (Fig. 5). As will be seen, the current enters the solenoid coil *g*, which is grounded, follows the tube *d*, making contact with the upper carbon by means of spiral *j* and carbon holder *i*, then it passes through the lower carbon through the conductor *y* to the resistance coil *f* and out of the lamp.

When the current is turned on the solenoid coil is energized, pulling up the core and drawing the arc, the length of which depends upon the amount of resistance in series with the arc, the strength of the coil, the amount of iron in the core and the weight to be raised. The dashpot, described above, compels the core to move upward slowly and steadily. It only acts when the solenoid is acting on the core, when the lamp is started or when a complete feed takes place. After the arc is drawn to, say, a length of ¾ inch, with 90 volts at the arc, this dashpot effect ceases and the core is left to move downward freely, responding to any current variations almost instantaneously and maintaining a uniform arc.

The amperage consumption may be varied between the limits of two and six amperes, by sliding the solenoid coil up or down. By lowering the coil the current consumption will be greater and by raising the coil the current will be smaller. The higher the coil

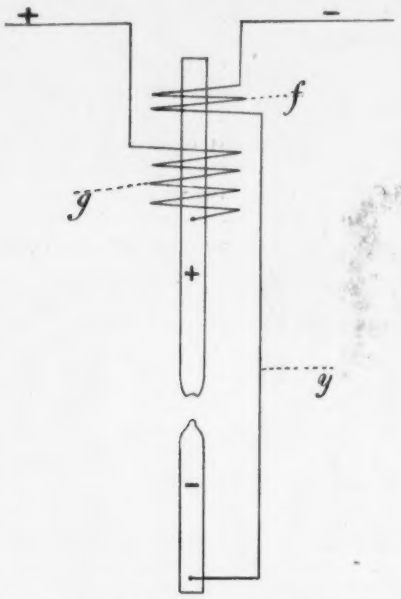


FIG. 5.—CONNECTIONS OF ENCLOSED ARC LAMP.

the greater will be the movement of the core as well as the length of the arc. It follows that with any given resistance in series with the arc, the shorter the arc the greater the current consumption, and vice versa.

The points of excellence claimed for the lamp may be enumerated as follows:

1. The lamp may be readily adjusted to take any desired current.
2. Any voltage, up to 102 volts, may be obtained at the arc, with 110 volts at the mains.
3. The lamp contains a minimum amount of resistance wire.
4. The core and clutch are combined. No mechanical clutch required.
5. The lamp is constructed entirely without wheels.
6. The lamp may remain on a dead short circuit for an indefinite period without injury to the lamp.
7. Most parts of the lamp are made of stampings.
8. No sliding contacts.
9. The lamp is easily recarboned.
10. Long hours of burning. With 7-16-inch carbons will burn 168½ hours.
11. Average feeding time every two hours.
12. Lamp to take 12-inch carbons is only 16 inches in length.
13. Lamp without casing weighs 3¼ lbs.
14. A minimum number of parts.
15. No carbon deposit on inner globe.
16. The lamp will accommodate itself to any reasonable rise or fall in the line voltage without a corresponding rise or fall in the amperage consumption.
17. The regulation is flexible and sensitive.

The lamp, which is now being placed on the market and has been in continued service at various places for a number of months, is made in several attractive styles, one of which is shown in Fig. 1, for continuous as well as alternating circuits.

The Electric Furnace in Industrial Chemistry.

THE last meeting of the American Institute of Electrical Engineers on Feb. 28 was devoted to the subject of "Electro-Chemistry," when several interesting papers were read.

Mr. Charles B. Jacobs, in a paper with the above title, briefly describes the several types of electric furnace used in industrial chemical operations and gives an account of some of the more important of these operations. He divides the industrial electric furnace into three general types, viz.: The reflecting arc furnace of the Moissan type, in which the heat of the arc is projected upon the charge by a reflecting surface; the direct-heating arc furnace in which the arc is surrounded by the material treated and imparts its heat directly to the charge; the incandescent furnace in which either the charge or the walls of the furnace form a part of the electric circuit, and by the resistance offered to the passage of the current produce the required heating effect. The two latter types are most frequently met with in commercial work.

Mr. Jacobs states that in furnaces constructed with linings of pure carbon blocks reinforced with some very poor conductor of heat, such as magnesia or chalk blocks, it is possible to obtain a temperature close to 4000 degs. C., at which temperature the purest carbon begins to vaporize. It is comparatively easy to operate commercially at temperatures ranging from 2500 to 3500 degs. C., and to raise a charge almost immediately to the required temperature.

Among the most striking of the new chemical combinations of the electric furnace are enumerated carbide of silicon, carbide of calcium and the silicides of the alkaline earth metals. The possibility has been demonstrated of using calcium carbide as a means of synthetically producing the valuable sediment of coal tar in a pure state and the compounds of the benzine series in general. In this manner a very pure sample of anthracene has been prepared by the Ampere Electro-Chemical Company, with which Mr. Jacobs is connected.

The carbides of the alkaline earth metals, being unsaturated compounds and capable of forming additional products, are of the highest interest. If one of these compounds be heated in the presence of some element having a stronger affinity for carbon than carbon has for itself, the bonds between the carbons will open and the new and stronger element will attach itself to the carbons of the carbide to form a saturated compound. Nitrogen, for instance, if passed through heated carbide of barium under the proper conditions will, at a certain critical temperature, combine with the carbide and form a cyanide of barium. The Ampere Company has taken advantage of this property in the production of cyanide of sodium and potassium, barium carbide being used as the absorber of hydrogen derived from the atmosphere and as the carrier of the cyanogen, which is subsequently converted by ordinary chemical means into sodium or potassium salt, the barium being used over again in the production of more barium cyanide.

Mr. Jacobs states that the silicides of the alkaline earth metals, viz., calcium, barium and strontium, were discovered by the Ampere Electro-Chemical Company in July, 1899. These compounds are formed in the electric furnace under conditions similar to those maintained in the manufacture of the alkaline earth carbides, although at a somewhat higher temperature. They possess a distinctly crystalline structure and oxidize slowly in the air at ordinary temperatures. Like the carbides, they decompose with water, but yield instead of acetylene, hydrogen in a pure state, which is evolved without explosion. Barium silicide seems to be rather the most important on account of its greater activity and the positive nature of all its properties. Strontium would answer as well for most purposes, but is more expensive and difficult to obtain. As a hydrogen producer, barium silicides probably offers the cheapest and most efficient source of pure hydrogen in commercial quantities. All of the silicides are strong reducing agents for both organic and inorganic compounds. Barium silicide has been used for the production of indigo, and seems to offer many advantages over certain reagents which it can replace. Various other uses of these silicides are

pointed out. Reference is made to the production of corundum from an amorphous alumina, such as bauxite or other aluminum compound, by a process invented by the Ampere Electro-Chemical Company, and now being operated by the Norton Emery Wheel Company.

It is stated that there are a number of instances in which it is advantageous to introduce the electric furnace to replace the ordinary means of bringing about chemical reactions that take place at high temperatures, and such substitution is, as a rule, merely a problem of economic engineering. The Readman process of the manufacture of phosphorus by the electric furnace is briefly described, and it is stated that by a process invented and developed by the American Electro-Chemical Company, barytes are treated in the electric furnace and from 97 to 99 per cent of the available barytes sulphate is converted into soluble form. An account of this process was printed in these columns in a recent issue.

Mr. Jacobs considers that probably no field offers so many important commercial problems as the chemistry of the gaseous elements, and referring to the importance of the atmosphere as a source of nitrogen compounds for the production of fertilizers, he states that it remained for Mr. Charles S. Bradley to introduce the energy necessary to bring about the combination of the oxygen and nitrogen in a commercial quantity. The work carried on jointly by Messrs. Bradley and Lovejoy has carried the problem of the fixation of the atmospheric nitrogen from the realm of experiment and placed it on a basis of commercial development. It is stated that in the combination of oxygen and nitrogen a number of extremely high-tension arcs are brought into intimate contact with carefully dried air, but the details of the process are not given; the results so far obtained have demonstrated on a practical scale great economy in the manufacture of nitric acid, and the nitrates and also nitrous acid and the nitrites, which makes possible the cheap production of all the commercial products which can be chemically derived from these compounds. In conclusion, Mr. Jacobs says that the electric furnace has offered a very plausible explanation of the occurrence of our natural gas, petroleums and bitumens, while the formation of graphite and corundum has thrown still further light on some of the phenomena and products of the various geological changes.

ELECTROLYTIC CONDUCTION WITHOUT ELECTRODES.

Mr. Carl Hering presented three papers, of which one treated of electrolytic circuits without electrodes. As it has always been found necessary to use electrodes in passing continuous currents through electrolytes, it has been claimed by some that electrodes must necessarily form a part of every electric circuit containing an electrolyte, or, in other words, that electrolytic conduction without electrodes is impossible. Some even go so far as to define electrolytic conduction by the action at the electrodes, and, according to such a definition, there would be no electrolytic conduction (as distinguished from metallic conduction), if no electrodes are used. The use of electrodes probably arises from the fact that it is the simplest means of connecting an electrolyte in circuit with a dynamo or source of current, or with measuring instruments. In view of the antagonistic theories concerning electrolytic conduction, it is of interest to know whether electrolytic conduction without electrodes is possible, and, if so, whether it is the same as when electrodes are used, assuming, of course, that any new products which may be formed at the electrodes are separated from the electrolyte under discussion by means of porous diaphragms.

The paper after giving a brief account of the state of the art, describes with the aid of a diagrammatic illustration a generator which enables the current which it generates to circulate in a complete circuit containing nothing but electrolytes, thus enabling this question to be investigated. The generator consists simply of a unipolar machine with a short circuited armature, which armature circuit consists entirely of electrolytes.

In such a circuit it seems that there could be nothing more than what the chemists call mere substitution, that is, a mere exchange of atoms or groups of atoms, as distinguished from a setting free of something or a reduction or oxidation. It does not seem possible that there can be any such true decomposition or setting free of something, without electrodes, and if this is correct, there would be no prospect of using such a method commercially for decomposition without electrodes, in order to get rid of some objections arising with the use of electrodes, as has been suggested by others. The questions discussed in the paper is, therefore, largely of theoretical interest. A proper settlement of the theoretical questions would, however, frequently be of use in practice.

POINT OF CUT-OFF IN A BATTERY DISCHARGE.

A second paper by Mr. Hering is on the limit of e. m. f. in storage battery discharge. In discharging a battery the voltage falls more or less gradually, and it is, therefore, often difficult to see just when the discharge should be considered ended, that is, what the proper point of "cut-off" of the discharge is. It is left to the experimenter, and is a purely arbitrary point. Sometimes it is quite important to have this point definitely fixed. This is the case, for instance, when batteries of different voltages are to be compared with each other, or when the discharges of the same battery at different rates are to be compared. After briefly referring to a number of cases in which this final voltage is determined by existing circumstances, the author describes two methods by which a definite point of "cut-off" can be found, thus eliminating the differences arising from arbitrary selections of the point of cut off.

The first of these applies to batteries which are to be used on constant potential circuits; that is, those in which all the voltage above the final must be absorbed by dead resistances. In such cases draw the voltage curve for a constant-current discharge, the abscissas being time, then find the point on the final bend of the curve at which a tangent cuts the axis of the abscissas at just twice the distance of the abscissa for that point. This is determined by trial, but is a very simple operation, requiring but one or two trials.

The second method, which applies to all cases, is simply to discharge the battery at constant power in watts instead of at constant current as usual, or at constant external resistance. The current must then, of course, be increased as the voltage falls, in order that the product shall always be constant. During the end of the discharge, when the voltage begins to fall more rapidly, the current will have to be increased quite rapidly, and a point will then very soon be reached when the battery is no longer able to give the current necessary to maintain the watts constant. This is, then, the end of the discharge, and is a very definite and fixed point found directly while the test is made and not afterwards. It leaves nothing to be determined arbitrarily by the experimenter, and is as fair for one battery as for another. A curve for such a discharge, of course, becomes a right angle. The paper shows these curves and gives also the volt curve and the ampere curve for such a discharge at constant watts.

LIQUID POTENTIOMETER; DETERMINING ELECTROLYTIC RESISTANCE WITH DIRECT-CURRENT INSTRUMENTS.

The third paper by Mr. Hering demonstrates that the potentiometer principle may also be used with certain precautions, with a column of an electrolyte in place of the usual potentiometer wire. It then affords a simple means of measuring the resistance of electrolytes with nothing but ordinary direct-current instruments. The apparatus is described and illustrated, and the precautions which are necessary in order to use it successfully are described. It consists essentially of a long trough of known cross-section, filled with electrolyte. Electrodes are introduced at the ends, and are separated from the rest of the trough by means of porous partitions. A current is passed through this column of liquid from an outside source, and there will then be a regular drop of potential in the column of the liquid, as in a potentiometer wire. Two electrodes, preferably of gold, but under no circumstances of platinum, are connected to a second battery, the voltage of which is known. The electrodes are in circuit in the column of the liquid, and are moved together or apart until any convenient galvanoscope in their circuit shows that no current flows. It is necessary, however, to approach the zero position from both sides to avoid finding false zero positions. At the proper zero position the current in that local circuit should change direction when the gold electrodes are moved a little farther apart and then a little closer together. The distance between them is then measured and the fall of potential in the column over that distance will then be equal to that of the local battery. From Ohm's law the resistance of the electrolyte between those gold electrodes can then be calculated, knowing the main current which flows through the whole column.

The theory of the action seems to be based on the condenser action of the auxiliary battery, as the deflections when the zero point is nearly reached are more in the nature of momentary currents like those for a condenser, as distinguished from continuous currents like those in the Wheatstone bridge method.

A paper read by Professor W. R. Whitney dealt with the class of substances known as colloids. He considers the difference between colloids in suspension and ordinary solutions. Whenever any substance, which is by nature insoluble in water is produced in water in

a very fine state of division, a permanent suspension or so-called colloidal solution will result if electrolytes be absent. This fine state of sub-division should exist (as it probably does) in all cases where insoluble substance is produced chemically *in situ*, for it is produced molecule by molecule. It should also exist where vapors condense in the water, as occur with subaqueous electric arcs between metal electrodes. The question is then discussed why such suspensions are not identical with solutions. The author concludes that if colloidal solutions or substances are made up of statically charged particles, the fact that they are precipitated by electrolytes, together with the quantitative relationships of this precipitation and the seeming probability that a part of the electrolyte is rendered insoluble in the process, make the connection of this phenomenon with the electrolytic association theory, a most natural one.

ELECTROLYTIC RECOVERY OF COPPER FROM LOW-GRADE ORES.

In a paper with the above title Mr. N. S. Keith described an electrolytic process of recovering copper from low-grade ores containing from ½ to 5 per cent of copper. The works are now being erected for the application of this process to the recovering of copper from the ores of a mine a few miles from New York City, containing about 2 per cent of copper to the ton.

The rock is broken in a crusher to the size of about ¾ to 1 inch cubes and smaller, after which it is dried by forcing heated air or furnace gas through the body of the crushings. It is then passed through a set of crushing rolls, which further reduce the size of the pieces to that of peas and beans, and smaller even, to sand and dust. Other operations then pulverize the rock so that it will all pass through the meshes of a No. 30 wire cloth having 900 holes to the square inch.

The next step consists in roasting the dust to expel the sulphur and oxidize the copper, which takes place continuously as the rock comes from the pulverizers, in mechanical furnaces fired by coal in seven fireplaces arranged along its side. From the discharge end the roasted rock is fed to leaching tanks.

In order to economize in the use of acid, there is mixed with the rock as it passes into the furnace some powdered ores preferably carrying at least a small percentage of copper, which serve to supply sulphur to be oxidized and unite with the lime in the ore to produce $CaSO_4$, while the copper therein is also recovered. The solvent consists of dilute sulphuric acid, the amount of the latter varying from 5 to 15 per cent of the water in the solution. The solvent is drawn off from the bottom of the leaching tanks, running through a filter bottom in a stream of perfectly clear greenish blue liquid. The first solvent run in during the filling of the tank takes up nearly all of the copper and runs out at the bottom fully saturated $CuSO_4$. As fresh additions of the solvent pass through, they carry decreasing quantities of copper until all of it has been taken up.

The solvent flows to deposition vats, which are so set at different elevations above the floor that the electrolyte runs by gravity from one to the next, and so on through the series to the end. Each vat has its electrodes connected in multiple, and the several vats of electrodes are connected in a series of 128, exactly as in the case of the large storage batteries. In order, however, to ensure a retrogressive decrease of the current at the electrodes of each vat after the first of the series, the number of electrodes is increased progressively from the first to the last of the series. For example, the density of the current may be 15 to 20 amperes per square foot of cathode surface in the first vat, and 3 amperes per square foot in the last vat. The evolution of the free oxygen at the anode keeps up a free mixing movement of the electrolyte in addition to the movement due to the flow through the vats. During the electrolysis there is a counter e. m. f. of 1-6 volt in each of the vat series.

As there are 128 vats and the generator is operated at approximately 240 volts, the total e. m. f. is 1.87 per cell, thus giving .27 volt for the resistance of the conductors, etc. The anodes and cathodes are of sheet lead. As soon as the copper deposit reaches a thickness of thin cardboard on the lead, it is stripped off and the two copper sheets thus produced have suitable connections riveted to them, and they are rehung as cathodes in some of the vats, where they remain a sufficient length of time to receive a thickness needful to market.

THE ELECTRO-CHEMICAL INDUSTRIES.

Professor Samuel Sheldon, in a paper with the above title, gives a general view of the present condition of the electro-chemistry industries. Aside from the manufacture of storage and primary batteries and electro-plating, it is stated that the carrying on of the industries considered requires over 200,000 hp, of which about 90 per cent is obtained from water power. An authority is quoted to the effect that the limit of cost per horse-power per year is from $5 to $50. At Niagara the price to large consumers is about $17, and power is delivered in Buffalo for about $30. The paper does not admit of abstract within the space here available, and, therefore, merely the heads will be enumerated.

Under the electro-deposition of metal there are taken up plating of gold, silver, nickel and brass, copper refining, parting of gold and silver, extraction of gold and extraction of nickel. In this section current density, circulation and dissociants are also considered. Under inorganic products the processes are described for producing alkalies and bleach, sodium, aluminum, sponge lead, potassium, ozone and nitric acid. Under the head of organic electrolytic products are iodoform, chloroform, bromoform, camphor, vanilin and artificial rubber. Under furnace products are calcium carbide, carborundum, artificial graphite, barium hydrate, barium cyanide, phosphorous, corundum and silicides. Under miscellaneous are considered electrolytic condensers, the electric rectifier and electrolytic interrupters.

American Street Railway Association.

At the meeting of the executive committee of the American Street Railway Association at Detroit it was decided that Wednesday, Thursday and Friday, Oct. 8, 9 and 10, 1902, be adopted as the meeting dates, with a reservation that Thursday, Oct. 9, be set apart especially for the exhibition of supplies, and that no regular proceedings be held on that day. The time for holding the annual banquet was also fixed upon as the evening of Friday, Oct. 10, 1902, at the Cadillac, which hotel was also selected as the headquarters of the association. The committee was unanimously of the opinion that the topics and papers to be read should hereafter be assigned directly to members of the association, and not to special officers of the different corporations. Seven subjects were selected, and the following designations made:

1. "Registration of Transfers," Cincinnati Traction Company, of Cincinnati, Ohio.
2. "Benefit Associations," Metropolitan Street Railway Company, of New York.
3. "Discipline of Employes by the Merit System," Metropolitan Street Railway Company, of Kansas City, Mo.
4. "Transportation of Light Express and Parcels," Detroit United Railway Company, of Detroit, Mich.
5. "Steam Turbines and Rotary Engines," Boston Elevated Railroad Company, of Boston, Mass.
6. "Signals for Urban and Interurban Railways," Union Traction Company, of Anderson, Ind.
7. "Settlement of Damage Claims," Chicago City Railroad Company, of Chicago, Ill.

The secretary was directed to write members urging the attendance of their representatives under such instructions that their presence in the convention hall at the discussions should be obligatory.

After the business meetings of the committee were concluded, Mr. Hutchins, of the Detroit United Railway Company, acted the part of host to the visiting members of the committee at a delightful dinner at the Detroit Club, and afterward during a pleasurable visit to the Yontodago Club.

The Light Guard armory hall selected for the meetings has ample space for the exhibits and meetings of the association, and is within easy riding distance of the Cadillac and other leading hotels of Detroit. It is understood that the local committee is arranging very pleasurable social features for the entertainment of the visiting delegates in October, and, as Detroit is a very attractive city, particularly in October, ample opportunity will be given for many excursions.

The Nice Observatory.

A cable dispatch from Paris of March 1 to a New York daily newspaper reports as follows: A curious lawsuit is pending between the Nice Observatory and a local electric tram car company using the Thomson-Houston system. The observatory authorities say that the electric instruments in their magnetic department were so much disturbed by the electricity of the tram cars that they were obliged to transport all the instruments to another observatory on Mount Mounier, at a lost of $20,000. They contend that the company ought to pay the cost, and the company is fighting the case.

The English Versus the Metric System.

BY CHAS. T. PORTER.

A BILL is now before Congress, and is in danger of becoming a law, which will make the use of the metric system of measurement compulsory in this country. The Society of Mechanical Engineers is issuing an appeal to its members to exert their influence individually with representatives in Congress to prevent the passage of this bill. At this juncture it seems important to present to engineers generally the point here made, which appears to me to go to the root of the matter. The bill is advocated on two grounds: First, that the metric is the only scientific system, and, second, that it is generally adopted, and uniformity in this respect is of the first importance. I have already, in an article in *Locomotive Engineering*, published in its issue of July 1897, pointed out the absurdity of this scientific pretension; showing that system of measurement to be only the decimal system, with a single arbitrary unit, different from the units employed by us, and to which single mode of division the metric system labors under the disadvantage of being limited.

I now propose to show further, that the English system, employing several units, commensurable with each other, adapted to different uses, and each divided by continual bisection, while making no pretension in that way, is in reality in the highest sense scientific or philosophical; and this by reason of a feature which is wanting in the metric system, and the want of which renders that system unphilosophical, unnatural and inconvenient for the purpose of mechanical measurement.

We employ four units of linear measurement—the mile, the yard, the foot and the inch. Each one of these units has its individuality and a distinctive name. The same is true of the parts obtained by continual bisection. Each of these also has its individuality and distinctive name.

The problem always is, How can the idea of any distance or dimension be formed in the mind and conveyed to other minds with the greatest distinctness? The answer is obvious. We must employ the largest available unit of measurement, and supplement this, as required, by smaller units, employing the largest available division formed by continual bisection. When the reality cannot be expressed in this way, then, and not till then, must we resort to the decimal system of division, the value of which, in this limited field, is beyond all estimation.

This mode of expression brings the distance or dimension before the mind with a definiteness which cannot even be approximated in any other way. This advantage is possessed by the English system of measurement, and is retained by it to the utmost useful limit. Thus, we do not say 17,600 yards, but 10 miles; we do not say 120 inches, but 10 ft. And so universally. By employing the largest suitable unit, we see the distance or the dimension as a vivid reality. We are enabled also to apprehend more clearly the relation to one another of the different members of any construction. We reach correct proportions more readily, are less liable to errors either of design or figuring, and are more likely to detect errors if these are fallen into.

This system is in accord with the divisions of the circle, and of time, which are universally employed. In the former we have three units—the degree, the minute and the second. In the latter we have centuries, years, months, weeks, days, hours, minutes and seconds. Each one of these units also has its individuality and its distinctive name. Here, too, we always employ the largest of these units that is applicable, and by this means, as is obvious to every one, the angle, or the interval of time is properly expressed to us. Any other mode of expression would be ridiculous. The decimal system is not resorted to, until we need it, to express divisions of the second, either the second of arc or the second of time.

This principle of employing the largest available unit is recognized by the French, in adopting the kilometer (1000 metres) as the unit for land measurement, and the meter as the unit for civil engineering work. Indeed, the French civil engineers have rather an advantage over our men, the meter being a larger unit than the yard.

But for the uses of the mechanical engineer all is reversed. Here the metric system bids defiance to this principle, and in place of the largest it substitutes the smallest unit, the millimeter (0.001 of the meter) nearly 0.04 inch, and all mechanical measurements are expressed in terms of this unit. Where we would write 10 inches, the metric expression would be 254 mm., approximately, as the two measurements cannot be expressed exactly each in terms of the other. Four feet eight and one-half inches is an illustration of our system of employing the largest unit, supplemented as already described. The definiteness of each item will be observed. The metric equivalent is 1434 mm.

This system, in its application to mechanical measurements, presents a dreary monotony of abstract figures, while the draughtsman is in a state of constant anxiety lest he misplace his decimal point. All this results from the fundamental error of employing the decimal system in a field to which it is not adapted.

It should be observed that, while our own decimal system is in decimals of an inch, we employ it in micrometer measurements only. Sometimes, however, for convenience, writing in decimals the fractions obtained by continual bisection.

It will be seen that the philosophical superiority of the English system lies in the fact, that figures express realities of distance or dimension with a definiteness that in the metric system cannot be approached. This is the secret of its greater convenience for mechanical measurements.

But uniformity! Everything, we are told, must be sacrificed to uniformity. I do not know why uniformity is of so much more consequence to us than it is to other people, that for it we must sacrifice what is priceless. Let other nations come to us. They have everything to gain by doing so.

There is also another view. English-speaking people have established the gauge system, about which other nations know nothing except what we have taught them. We have been at immense pains to obtain the ideal inch, with its divisions on the natural system of continual bisection, and its multiples, and their combinations, with the utmost exactness, as concrete realities. These are in universal use with us. All our mechanical construction is adapted to them. The universal screw-thread system, another Anglo-Saxon gift to the world, is founded upon them. All this also we are to be compelled to throw away. This would involve a loss and confusion, beyond all power to estimate.

This, however, is nothing compared to the abandonment of the philosophical principle, on which our system of mechanical construction rests. How little do our legislators imagine what it is they are meddling with.

Is there not power enough in the English-speaking people to defend for their own mechanical engineers the invaluable principle of employing the largest unit of measurement, and, moreover, to make its application as universal for constructive work, as it is for everything else, for the civil engineer, for geographical measurement, for the circle and for time?

Cables and Wireless Telegraphy.

In the course of his annual report the figures of which are noted elsewhere, President Ward of the Commercial Cable Company, says: "The shareholders of the company will no doubt expect some expression of opinion from the officials of the company in respect to wireless telegraphy. While we do not intend to belittle the credit due to Mr. Marconi for the advancement he has made in that field, we have every confidence in the ability of submarine cables to maintain their commercial supremacy in competition with wireless telegraphy, even should it ever extend beyond its present experimental stage as regards transatlantic or other long-distance transmissions.

"Our shareholders must not overlook the fact that it has taken the Commercial Cable, and its land line system (Postal Company) some 17 or 18 years to perfect their organization for the distribution and collection of telegrams throughout the United States and the rest of the world. Assuming that the Marconi system should become perfected so that it could really compete in a commercial sense, and commercial requirements are very exacting, it is fair to say that it would take as many years to put the Marconi system in a position as would enable it to serve the public.

"Messages are now transmitted across the Atlantic and answers received in two and three minutes. A message experiencing a delay of 10 or 15 minutes means the defeat of the object of the sender. A most important point is the fact that 95 per cent of the Atlantic messages are expressed in code or cipher language, the words or ciphers having no connected meaning. The words or cipher groups frequently only differ from each other in single letters, yet they have widely different meanings, and an error in the transmission of one of their letters might have disastrous consequences. These are some of the commercial exactions or demands made upon the telegraphs.

"No one has yet even pretended that the speed with which messages may be transmitted by wireless apparatus even approaches the speed of the aerial or submarine wire, and among submarine wires those of the Commercial Cable Company stand pre-eminent, not only for speed, but for accuracy and reliability of communication."

Mr. Marconi's Latest Achievement in Ocean Wireless Telegraphy.

BY WILFRID BLAYDES.

G. MARCONI.
(From an unpublished photograph.)

BUT a few weeks have elapsed since the civilized world was startled by the report that Mr. Marconi had succeeded in receiving near St. Johns, Newfoundland, telegraphic signals transmitted through space from Cornwall, England. Already, however, the energetic inventor is once more to the front with yet a new record of marvelous accomplishment. He has followed up the feat of Signal Hill by a series of achievements on board the U. S. M. S. "Philadelphia," beside which the former will seem to many but a *tour de force*. Some account of these will doubtless be of interest to the readers of ELECTRICAL WORLD AND ENGINEER.

Mr. Marconi only reached London on his return from his last visit to the States on the 26th of January. In the interval between this date and the 22d of February, when he again sailed for New York, besides transacting a large amount of business in London, he paid visits to several of his stations, and in particular spent four days in overhauling and testing the transatlantic plant at Poldhu, Cornwall. He there arranged the exact conditions which he wished to rule during the sending of signals and messages to him at stated hours throughout his then forthcoming voyage on the "Philadelphia." The nature of those conditions I am, of course, not at liberty to reveal. The letter "S" being the easiest letter in the Morse code to transmit is habitually used by Mr. Marconi for his initial tests in connection with any experiments which he may be undertaking for the first time, and for which, naturally, he wishes to secure conditions as favorable as possible. The signal letter to be transmitted was, therefore, S, as in the case of the Newfoundland test. The plan adopted was that it should be sent for an hour at a time—with five minutes' rest after each ten minutes of sending—at fixed intervals from Saturday afternoon, Feb. 22, up to Saturday night, March 1. Also, however, upon this occasion, messages were to be dispatched at the rate of one message to each hour's sending of the "S" signals. In the case of the Newfoundland land test, it will be remembered that only the latter were sent.

Upon the ship an aerial height of about 150 ft. had been obtained by the lashing of a stout spar to the head of a mast, and a quadruple aerial was used. The receiving apparatus had been conveniently sheltered in a deckhouse aft. Mr. Marconi's stateroom adjoined the instrument room, as, indeed, it was necessary that it should, in view of the hours, sometimes 2, 3 and 4 A. M., at which he required to be at his receivers. The apparatus was tested in the morning of the 22d while the ship still lay at her pier in Southampton docks, and the signals from Poldhu seemed quite unaffected by the fact that they were then traversing a distance much of which lay overland.

It was late in the afternoon of Feb. 22 when the "Philadelphia," having taken on board the mails at Cherbourg, started on her westward journey. Using an ordinary duplicate aerial, some communications took place in the ordinary way with the Marconi Channel stations at Nilton, Isle of Wight, and the Lizard, but it was not until we had reached a point 250 miles west of the Lizard that the big power experiments seriously commenced. From the first, it was seen that there was no doubt whatever about their success. The sensitiveness of the adjustments with which the best results were obtained increased only slowly, and for the first thousand miles, Mr. Marconi found that he had no need to use any adjustment whatever of special sensitiveness.

I remember very well the excitement with which we all assembled to watch the signals come for the first time over a thousand miles. We were not long left to wonder what the result would be, however, for immediately the connection was made, the "S" signals came ticking off on the tape as strong and regular and clear as I have heard them at 30 miles. I should mention that most of the messages received were of a private character, referring principally to conditions in the transmitting house at Poldhu. I subjoin, however, a copy of five messages to which no such remark applies, together with the dates and distances at which they were received on board the "Philadelphia":

Date.	Distance. (Statute Miles.)	Remarks.
Feb. 23.	250	Stiff southwest breeze, fairly heavy swell.
Feb. 23.	500	All in order. Sign.: Do you understand? (This in code.)
Feb. 24.	1032	Fine here. Thanks for message. (Sent previous day.)
Feb. 25.	1163	May every blessing attend you and your party.
Feb. 25.	1551	All in order. Sign.: Do you understand?

This was the last message received, though good "S" signals were received with a somewhat sensitive adjustment, which the rolling of the ship made it difficult to maintain, up to 2099 miles on Feb. 26. All the messages were followed by the code signature of the Poldhu station, and upon every occasion Mr. Marconi, mindful of the scepticism with which his Newfoundland results were received in certain quarters, made a point of receiving the signals and messages in the presence of independent witnesses, and throughout he used also the ordinary tape receiver for the purpose. The tape records were duly attested in each case by Captain Mills, his chief officer, Captain Marsden, or others of the ship's officers. We may, therefore, suppose that this time the scepticism to which I have alluded will find little to feed upon.

Received on S.S. Philadelphia Lat 42.1 N. Long 47.23 W distance 2099 (two thousand and ninety nine) statute miles from Poldhu
Capt C.A. Mills

FAC-SIMILE OF TAPE RECORD OF SIGNAL RECEIVED AT DISTANCE OF 2099 MILES.

(The tape bears the witnessing signature of Captain Mills, S. S. "Philadelphia.")

The net results of these tests which have so completely borne out Mr. Marconi's calculations are in themselves sufficiently stupendous, without there being any need to look forward to the day, now very near at hand, however, when they will receive their crown and completion in the commercial establishment of transatlantic wireless telegraphy between stations in America and Europe. It should be remembered, too, that they have been obtained with, at Poldhu, a purely temporary installation so far as aerial capacity is concerned. I think I shall be correct in fact if I say that the electrical energy which has sufficed to send legible signals over a distance of 2099 miles—a distance somewhat greater, by the way, than that covered in the Newfoundland test—is not much more than one-tenth of the supply which Mr. Marconi will have available as soon as the work of tower erection now in progress at Poldhu is completed, as it may be expected to be within a very short time. As Mr. Marconi has now demonstrated that the limit of the distance over which his system can work is conditioned only by the amount of power available, the curvature of the earth being apparently immaterial, the extra thousand miles is not a consideration which need present much difficulty to those who are interested in transatlantic wireless communication.

Incidentally, I may conclude by remarking, his work on the "Philadelphia" has afforded a quite admirable illustration of the nicety of Mr. Marconi's "tuning" devices. The "Umbria," which followed the "Philadelphia" across the ocean at the distance of only a day's steam, failed to receive a single one of the signals, which yet were all the time flashing over her to Mr. Marconi's (differently tuned) receiver.

Stealing Electrical Energy.

The Ohio Senate has passed a bill providing for a penalty of from $50 to $100 fine, or from one to three years imprisonment for stealing electrical energy by tapping wires or by any other means.

Marconi-Canadian Transatlantic Rates.

A special dispatch from Quebec of Feb. 27 says: Ten cents a word for ordinary transatlantic telegraphic messages, with a press rate of 5 cents a word, is the rate to be enjoyed by Canadians in the near future in virtue of the recent arrangement made by the Dominion Government with Signor Marconi. The details of the contract have just been made public. The Government will contribute $80,000 toward the erection of a station in Nova Scotia, according to plans and specifications prepared by Marconi himself. Should the station cost more than that amount the additional expenditure will be borne by the company. The company agrees that the rates to be charged for messages between Canada and Great Britain shall not exceed in any case the rates charged for similar messages between Great Britain and any other parts of North America. If the company's operations are successful, it undertakes to transmit general messages at rates which shall be fully 60 per cent less than the rates now charged for cablegrams between Canada and Great Britain. In other words, whereas the rate for general messages is at present 25 cents, the company will charge not more than 10 cents a word. The company, as far as possible, will use Canadian machinery, material and labor in the construction of the station in Nova Scotia.

The Canadian Government undertakes that all messages received by the company, or intended for transmission by the company, shall be sent over Government telegraph lines now existing, or which may hereafter be constructed or operated by the Government, at rates not higher than those charged to others for ordinary commercial messages.

If the Government desires to use the Marconi system as a means of communicating with any of the lighthouses or life-saving stations on the coast or between the mainland and any island within the jurisdiction of Canada, it is free to erect such stations as it may require. In such cases the company must furnish all machinery needed for such stations at a fair and reasonable price, and free from any charge for patent rights or royalties. It is agreed that there is to be no discrimination on Marconi's part in favor of the United States.

New Telephone Patents.

The issue of Feb. 25 contains but three telephone patents, one relating to a sanitary shield for transmitter mouthpieces, the other two to switchboard systems. It is questionable whether it is worth while to patent such devices as the sanitary shield invented by M. Jean B. Tauveron, of New York. For one thing very few people would bother to use such a device, for another it would undoubtedly impair the efficiency of talking, and for still another it would be very easy to provide, were such a precaution considered really necessary, a much simpler and more effective shield to be thrown away after each conversation, such as a paper cup or funnel shaped exactly to fit the mouthpiece, which would be thoroughly "sanitary," and at the same time have absolutely no effect on the quality of the talking. The necessity for such a device has never really made itself felt, however, despite occasional scare articles in the daily papers. Granted that the idea of using a much-used public telephone is disagreeable to the squeamish-minded, there are hundreds of daily experiences in a big city equally disagreeable or more so, and it has never been proved that the public telephone is a real source of danger. In fact, such investigation as has been made has shown the contrary.

Mr. Fauveron's shield consists, as shown in the drawing, of a support of pasteboard with folding flaps to fit over the mouthpiece. The diaphragm or shield is of thin moisture-proof paper pasted to a support and having an extension or strip which forms a wrapper for the support and shield, enabling a sealed package to be made of the appliance by means of the mucilage indicated at the rounded end. The small figure shows the shield made up i na sealed package, which may be carried in the pocket without soiling of the shield proper. In this way, too, the user is sure of getting a fresh and uncontaminated shield.

Two patents of a more ambitious character are granted to Mr. William S. Paca, of Erie, Pa., assignor of three-fourths to Messrs. Peter H. Adams and John Z. Miller, of the same place. The object of Mr. Paca's invention, which he describes in two specifications adapted to different methods of exchange signaling, is the provision in a telephone exchange of a second switchboard, auxiliary to the main multiple switchboard, for the purpose of handling overflow

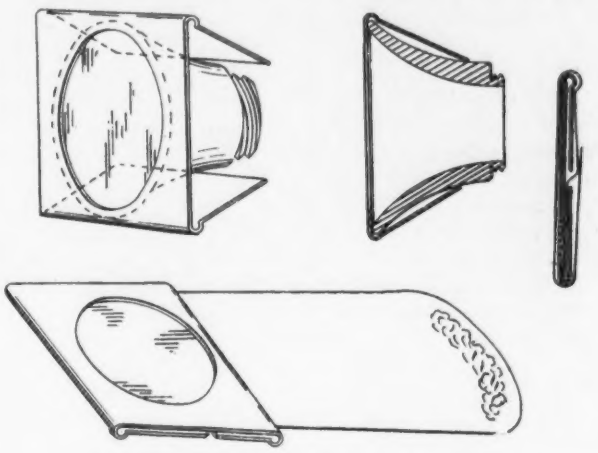


FIG. 1.—SANITARY SHIELD FOR TRANSMITTERS.

traffic at extra busy times. The idea is almost as old as the multiple switchboard itself, has been tried in practice—though not exactly according to Mr. Paca's method—and has been found wanting, and it has disadvantages much more obvious and more numerous than any possible advantages.

Mr. Paca's plan is pretty clearly indicated by the preamble to his specification, as follows: "Necessarily during the busy portions of the day the operators at multiple sections have great difficulty in answering the calls promptly, as at such times there are frequently several calls in such sections at the same time, and the operator is then obliged to answer the calls and make the necessary connections one at a time, which necessarily causes considerable delay to some of the subscribers so calling the exchange; and to overcome this difficulty it is frequently necessary to decrease the number of connections in particular sections of the board, as the calls at such sections during the busy part of the day are so frequent that the operator at such

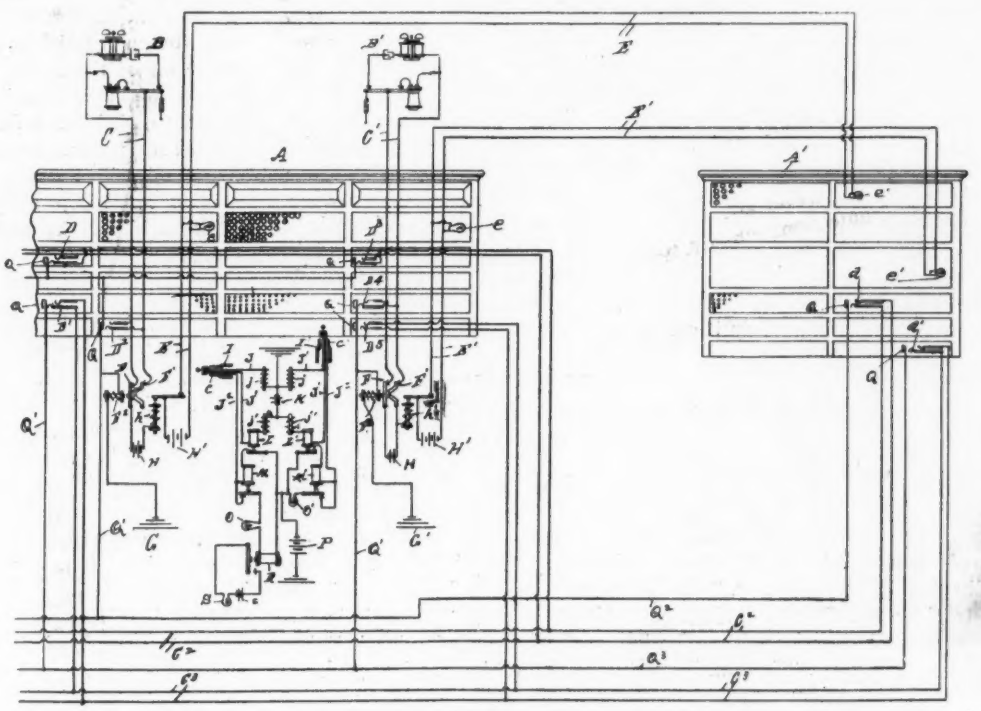


FIG. 2.—PACA'S TELEPHONE SWITCHBOARD SYSTEM.

section cannot answer them promptly, and in some cases two operators are placed at one section to overcome this difficulty. I entirely overcome this difficulty by means of an auxiliary switchboard, which is so connected up with the main switchboard that one or two operators at the auxiliary board can at any time promptly assist the operators at busy sections of the main board, so as to avoid delay in promptly answering calls thereto, and when desired—as, for example, at night, when there are comparatively few calls—one or more operators at the auxiliary board can promptly answer all calls coming into the exchange."

Fig. 2 illustrates the invention applied to common battery working, *A* being the main switchboard and *A'* the auxiliary board, which is apparently intended to be non-multiple, but in an exchange of more than a few hundred subscribers would necessarily have to be multiple, as the line signals and jacks could not be put near enough together to enable connections at the auxiliary board to be made directly between line jack and line jack. Moreover, in small exchanges the trouble which this device seeks to remedy does not exist, and in large exchanges the adoption of the system would practically result in two multiple boards in tandem, each subscriber's line having a line signal and answering jack in each and a multiple circuit in each; all so that the operator at the second board might take up a connection if the call were not immediately answered at the first.

In Fig. 2, station *B*, line *C*, besides its regular jacks and connections in the main multiple board *A*, is bridged to jack *d* in the auxiliary board *A'*, and has a line signal *c'* in board *A'* bridged on to the local circuit of its main line signal *e* in board *A*. Similarly, station *B'* has jack *d'* and signal *e'* in board *A'* bridged on to its regulation equipment in main switchboard *A*. The remainder of the apparatus shown in Fig. 2 is in the main that used in standard common battery practice and needs no description. Cord circuits similar to those shown at *A* would naturally be needed at *A'*. According to this system a call from a sub-station would light the lamps at both boards, and presumably the operators at both boards would endeavor to answer every call, with a resulting amount of confusion that may be imagined.

The whole idea underlying this invention is wrong. The inventor has set out to break a butterfly on a wheel or to build an elephant trap to catch a mouse. In the first place, Mr. Paca, when he says that at busy times "the operator is obliged to answer the calls and make the necessary connections one at a time," does the expert telephone operator great injustice. She thinks nothing of handling several connections at once during busy times. Then the supervisor, able to cut in and help at any position at any moment when an operator is temporarily overloaded, and the intermediate distributing board provide far better remedies for the difficulty Mr. Paca has set out to cure than his scheme of an extra signal and jack at a separate board. The auxiliary board would not only largely increase the cost and operating expenses of an exchange, but it would introduce troubles in operating far worse than those it is designed to remedy. The responsibility for attending to calls would be divided, the main and auxiliary operaotrs would inevitably often meet on a subscriber's line, the auxiliary operators would get many calls they could not handle unless the whole exchange equipment were duplicated at the auxiliary board and in turn would become overloaded themselves. In short, the scheme is one which, however attractive it may look on paper, meets with many practical objections when it comes to actual operation.

American Institute of Electrical Engineers.

At the 162d meeting of the Institute, held at 12 West Thirty-first Street, New York City, Feb. 28, 100 members and guests were present, with President Steinmetz in the chair. The following papers were read: 1. "The Electro-Chemical Industries," by Dr. Samuel Sheldon, of Brooklyn. 2. "The Electric Furnace in Industrial Chemistry," by Mr. Charles B. Jacobs, of New York. 3. "Electrolytic Recovery of Copper from Low-Grade Ores," by Dr. Nathaniel S. Keith, of New York. 4. "Colloids," by Mr. W. R. Whitney, of Boston. 5. "Liquid Potentiometer; Determining Electrolytic Resistance with Direct-Current Instruments." 6. "Point of Cut-off in a Battery Discharge." 7. "Electrolytic Conduction Without Electrodes," by Mr. Carl Hering, of Philadelphia.

These papers were discussed by the different authors, also by Messrs. C. J. Reed and E. P. Thompson. They are abstracted elsewhere in this issue.

CURRENT NEWS AND NOTES.

LEHIGH SCHOLARSHIPS.—Among eight scholarships to be competed for at the annual examinations in June of Lehigh University, are one in electrical engineering, and another in mechanical engineering, to the value of $150 each.

JAPANESE INDUSTRIAL EXHIBITION.—A national industrial exhibition under the auspices of the Japanese Government will be held at Osaka in 1903, and foreign manufacturers are invited to exhibit. Foreign exhibitors will be granted special protection with respect to patents.

CONVENTION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—It has been decided to change the meeting place of the next annual convention of the Association of Railway Telegraph Superintendents from Boston to Chicago. The meeting will take place on June 18 next. The Association was organized in Chicago in 1882, and has not held an annual meeting there since.

ELECTRICITY ON THE MANHATTAN.—It is announced that up to this time there have been delivered and placed in service on the Second Avenue Elevated line, in New York City, six electric trains of full length. The operation of these trains has been quite satisfactory, and there can be no question of the complete success of electric traction. Installation of machinery in the power house is going steadily forward, progress in this matter keeping pace with the increasing number of trains available for service. The third rail is being laid on other lines of the system, but as this is a comparatively easy matter no effort is being made to rush it to completion. Everything depends on delivery of equipment, and in this fair progress is being made.

DATA ON SHOCKS.—A cable dispatch from London of March 1 says: The cause of temperance has suffered a cruel blow by a disclosure made in a paper on "Electric Shocks," which was read by Mr. F. F. Aspinwall before the Institution of Electrical Engineers. Mr. Aspinwall has been carefully investigating the subject for some years, and collecting all available data of instances of people being "shocked" by an electric current. He comes to the conclusion that a severe shock, strong enough to kill a man if sober, will probably not kill a man if he is drunk. This is due probably to the relaxed conditions of the nerve system. If the man has been working hard enough to throw him into a perspiration he has a good chance of escaping with his life from an otherwise fatal shock. People in bad health are much more sensitive to electric influences, while persons of weak intellect can stand stronger shocks than those of normal intelligence. Sleep also renders a person able to stand electric shocks, which if he were awake would be strong enough to cause death.

INDUCTION MOTOR WITHOUT IDLE CURRENT.—A patent issued Feb. 25 to Ernst Danielson, of Westeras, Sweden, describes an induction motor combination designed to eliminate the defect of induction motors in loading up a line with idle current. A direct-current exciter is mounted on the same shaft with the rotor of the induction motor. The motor is started as usual with a starting resistance in the rotor, and after it has gotten up to speed a double-throw switch cuts out the starting resisance and throws the armature circuit of the exciter into series with the rotor winding, thus causing the motor to act as a synchronous motor. By suitable adjustment of the exciting current by means of a rheostat in the field of the direct-current exciter, the phase relations of the current and the e. m. f. of the motor can be regulated within quite wide limits and made equal to zero or leading or lagging at will. When the exciting circuit is thrown on the rotor, one terminal of the exciter becomes connected to one collector ring and the other terminal to both of the other collector rings, the result being that the current strength in the coils belonging to one phase will be twice that in each of the others, which is stated to accurately correspond to the distribution of current maintained at certain moments when the coils are traversed by three-phase currents.

ANOTHER RURAL THIRD-RAIL ROAD.—Right of way is being acquired by the promoters for a third-rail road from Hudson to Poughkeepsie, passing through Red Hook and Rhinebeck and in Poughkeepsie crossing Main Street overhead. The project also embraces a railway to some point near the city of New York. Much of the right of way has already been secured. A corps of surveyors is now in the field. The third-rail trolley line from Hudson to Albany is paying, and lines are either in operation or being built from Albany to Utica, to Syracuse, to Rochester, to Buffalo and to Cleveland. Benjamin H. H. Brevoort, of Poughkeepsie, is the chief engineer of the road, and he and his assistants have been running lines since September last. Two lines have been run between Hudson and Poughkeepsie. Southward the line is proposed to run near Vassar College and then through the country to a point near Hopewell, and from there to Carmel over the old Boston and Montreal roadbed. There is every indication that this road will be built and that it will be equipped for both freight and passenger service.

APPARATUS FOR PREVENTING COLLISIONS AT SEA.—In a patent issued Feb. 25 to Nicolas Gherassimoff, of St. Petersburg, Russia, a curious arrangement is proposed for preventing collisions at sea. The object of the arrangement is to ensure against collision between the ship and any moving or stationary body situated in the path of the ship, either at the surface or at a depth less than the draught of the ship, and also to give warning of shoals. Electrically propelling bodies or "feelers" move in advance of and at substantially the same rate of speed as the ship, and at such a depth under water as to come in contact with any obstruction at a depth less than the draught of the ship. There are three of these "feelers," one of which moves in a line with the keel and the other two in paths to the right and left of this line, respectively. The three electric cables controlling the feelers are united at a point such that this point and the position of the three feelers are at the corners of a square; a cable from the junction point is connected with indicating apparatus aboard ship. The "feelers" are given motion by an electric current generated on the ship, and are provided with mechanism connected with indicating apparatus aboard ship to indicate the deviation in one direction of the two outside feeders and the deviation in either direction of the third or leading feeler. Each feeler is supplied with a luminous floating signal carried by a buoy at the surface of the water. The indications aboard ship denote also whether a feeler has come into contact with a floating obstruction or is over a shoal.

INDUCTION MOTOR STARTING APPARATUS.—Among the patents granted Feb. 25 is one to K. A. Lindstrom, of Sommarrs, Sweden, which relates to a new starting system for induction motors. The two usual methods of starting induction motors are by varying the primary e. m. f., or using a starting resistance in the secondary circuit. An objection to the former method is stated to be that a great current strength is required in starting and a small torque is obtained in proportion to the current. While the second method combines the advantage of a great torque in comparison to the current strength, yet the use of a starting apparatus is necessitated, which, owing to sparking or chemical influences Mr. Lindstrom considers is subject to considerable wear and is easily destroyed. The Lindstrom patent provides for use in starting of an inductive resistance having a small ohmic resistance and provided with a magnetic core, the hysteresis losses of which are great in comparison to the losses due to eddy currents in the same. As illustrated, the apparatus for a star rotor winding consists of three coils having a common point and wound on three cores so arranged to have a common magnetic circuit. In one form shown, the three cores form the spokes of a ring casting. The core windings are connected together at one end, the other ends leading to switches. In starting up the rotor windings are connected by collector rings and brushes to the three terminals of the windings of the core. After the motor has gotten up to speed the starting device is cut out and the rotor windings are short circuited on themselves. The specifications give a mathematical demonstration to show that with a properly designed magnetic core and windings of the kind described, the current taken in starting by the primary of the motor will not materially exceed that required for the motor for its normal running at full speed and for the same torque. In order to obtain with small weight great hysteresis losses in the core and, therefore, small shifting of phase, a material such as steel or gray cast-iron is used, the coefficient of hysteresis of which is great; and in order to obtain small loss by eddy current the core is minutely sub-divided.

LETTERS TO THE EDITORS.

Generator Heating Limits and the A. I. E. E. Standard.

To the Editors of Electrical World and Engineer:

Sirs.—A misconception not at all of rare occurrence appears to exist as to the rating of generating machinery under the standards recommended by the committee of the American Institute of Electrical Engineers. This misconception cannot by any means be said to be confined to a few ignoramuses, for some very large contracts have been placed by experienced engineers and filled by equally experienced manufacturing companies on a wrong basis, due simply to a misconception or to carelessness as to what the A. I. E. E. standard actually is and how it should be applied in practice. In some cases the mistake has cost thousands of dollars.

The misconception on which these mistakes in ordinary generators have been based is that the maximum allowable rise in temperature in the A. I. E. E. recommendations (which is 50 degs. C.) is one that will prevent a generator from reaching an unsafe temperature in all conditions that can arise in an engine room in very hot weather. To be sure, no one in these days expects to design an engine room so that ordinarily the temperature is so high that 50 degs. C. added to it would burn out a generator; but with the thermometer outside reaching 100 degs. F. and high pressure steam in the engine room, it takes more than ordinary precautions in power house design to keep the generator temperature down to a safe amount at full load with a rise of 50 degs. C. in the generator coils above the surrounding air, unless considerable floor space is used per kilowatt of power station capacity.

This is a point that has not been taken into consideration in the cases referred to, the order being simply given for a generator of so many kilowatts capacity, A. I. E. E. standard. The result is either a burn out if the generator is run fully loaded or a reduction in the capacity of the generator in the hottest weather. In the case of railway generators this means a reduction of generator capacity just when riding is most popular and when people take to the cars to keep cool. In a lighting machine the discrepancy between rated and actual safe load in hot weather would not be so important because the heaviest loads come in midwinter.

The conclusion is that the A. I. E. E. standard of allowable temperature rise was chosen to fit average conditions and should not be blindly adhered to when abnormal conditions are likely to exist in operation, as in crowded engine rooms near high-pressure steam cylinders and piping.

PHILADELPHIA, PA. JAS. L. BARR.

Measuring Three-Phase Circuits.

To the Editors of Electrical World and Engineer:

Sirs.—Referring to the letter of Mr. Stratton in your issue of Feb. 22, if the watts input of an induction motor are measured by two wattmeters connected in the way the wattmeters are connected up in Mr. Stratton's diagram, the readings of both instruments are not the same unless the power factor of the whole system is unity. The power factor of the motor on which Mr. Stratton made his test is

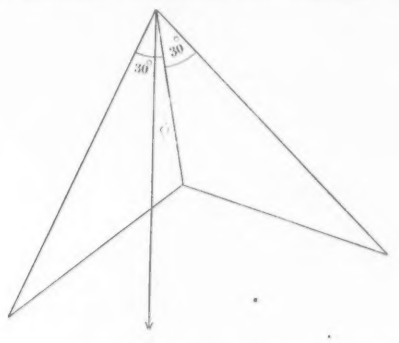


FIG. I.—MEASURING THREE-PHASE CIRCUITS.

88.8 per cent, but it is a bad fallacy to reason the way he has done.

He has the pressure coils of his wattmeters connected between the *outside* wires, and he, therefore, does not measure the watts in an individual leg. If he had connected his pressure coils between the outside terminals and the neutral, then he would have received very

different results, viz., the watts in each leg would have been the same.

Referring to the accompanying diagram, the power is $I E \cos 30$ degs. if the load is non-inductive. If inductive, the power is $I E \cos (30 \text{ degs.} - \phi)$ or $I E \cos (30 \text{ degs.} + \phi)$, the power factor being $\cos \phi$.

BOSTON, MASS. S. L. LONG.

To the Editors of Electrical World and Engineer:

Sirs.—Perhaps the simplest way to explain to Mr. Stratton why he obtained the results given in his letter of Feb. 22 will be to explain the theory of two-wattmeter, three-phase measurements.

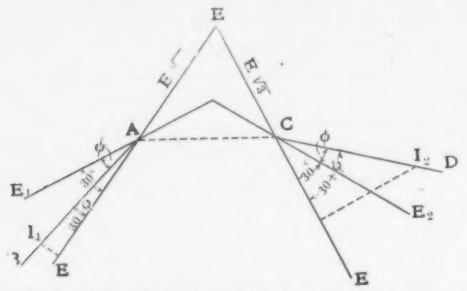


FIG. 2.—MEASURING THREE-PHASE CIRCUITS.

The total power in a three-phase balance system can be measured by means of two wattmeters, each connected with the current coil in one of the lines and the potential coil between these lines and the third. Since the e .m. f. in the potential coil is displaced in phase from the current in the line, it is evident that each wattmeter does not give the power of each individual phase. It is easily demonstrated, however, that the sum of the two readings regardless of the phase relation of current represents the total power in the three-phase system.

Let in Fig. 1 the phase of the current be represented by line $A B$, lagging by the angle ϕ behind the e. m. f.; $C D$ the current in the other phase lagging the same angle behind its e. m. f., and let these two currents be used in the current coils of the two wattmeters having the potential coils connected across $E A$ and $E C$, respectively. The power measured by the first wattmeter will then be $I_1 \times E \times \sqrt{3} \times \cos (30 - \phi)$. The power read in wattmeter No. 2 will be $I_2 E \sqrt{3} \cos (30 + \phi)$, where I_1 and I_2 are represented by $A B$ and $C D$, respectively. In a balanced system I_1 is equal to I_2; E is the e. m. f. per phase, so that the line voltage is $E \times \sqrt{3}$, and consequently the sum of the two wattmeter readings will be $E \times \sqrt{3} \times I \times \cos (30 - \phi) + E \times \sqrt{3} \times I \times \cos (30 + \phi)$.

By solving this equation we find the total power to be $\sqrt{3} \times E \times I \times \cos \phi$, which is the sum of the power in each of the three phases with the current lagging an angle ϕ behind the e. m. f. This proves that this method of connecting two wattmeters gives the total power

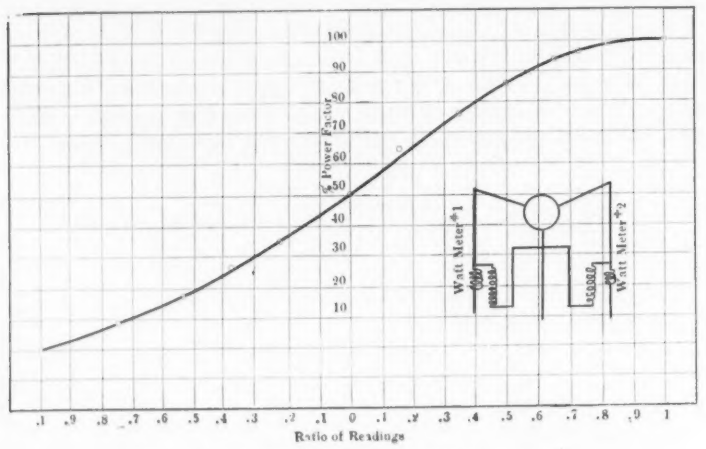


FIG. 3.—MEASURING THREE-PHASE CIRCUITS.

in the three-phase circuit, regardless of the phase relation of currents. The ratio between the two wattmeter readings

$$\frac{\cos (30 - \phi)}{\cos (30 + \phi)} = \frac{\sqrt{3} \times \cos \phi - \sin \varphi}{\sqrt{3} \times \cos \phi + \sin \phi}$$

Substituting different values of ϕ in this equation we find the relation between ratio of wattmeter readings for different degrees lag of current and different power factors. This is plotted in Fig. 3.

In the particular case referred to in Mr. Stratton's letter, where one meter reads 3600 and the other 8000, the ratio is .46 and, consequently, the power factor, according to the curve, is 84.5.

SCHENECTADY, N. Y. E. J. B.

To the Editors of Electrical World and Engineer:

Sirs.—In regard to the problem encountered by Mr. Stratton in testing a three-phase induction motor, an account of which appeared

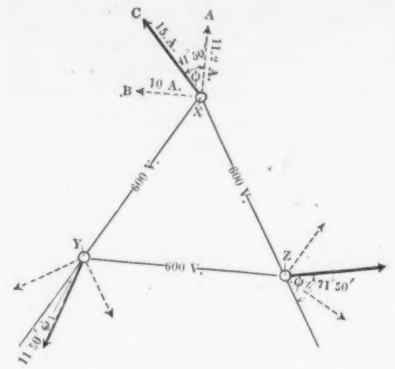


FIG. 4.—MEASURING THREE-PHASE CIRCUITS.

in the issue of your paper for Feb. 22, permit me to offer the following solution:

Assuming the total watts supplied to the induction motor to be $8000 + 3600 = 11{,}600$, the e. m. f. per phase 6000, and current per lead 15 amperes, the following calculations would be made:

Power factor $= \cos \phi = \frac{11{,}600}{15 \sqrt{3}\ 600}$	$= .745$
Angle of lag $= \phi$	$= 41°.50'$
Wattless factor $= \sin \phi$	$= .667$
Power component of current	$= 11.2$
Wattless component of current	$= 10.0$

Referring now to the diagram, it will be seen that a wattmeter having its current coil in lead Y, and its pressure coil across between this lead and lead X would register

$$I E \cos \phi_y = 15 \times 600 \times .9787 = +8800$$

While a wattmeter with current coil in Z and pressure coil across $X Z$ would register

$$I E \cos \phi_z = 15 \times 600 \times .3118 = +2800$$

It is evident that so long as the angle ϕ_y remains less than 90 degs., the record of the wattmeter at Y will continue to be positive in value, and that the wattmeter at Z will give a positive reading up to that angle of lag which causes ϕ_z to become 90 degs. This latter condition will be reached when ϕ, the lag of the current in each lead wire behind the e. m. f. between that lead and the neutral point, becomes (90 degs. — 30 degs.) = 60 degs., at which time the power factor of the *system* will be $\cos 60$ degs. = .50, but that of wattmeter at Y, if the term "power factor" can be used here, will be $\cos 30$ degs. $= \frac{1}{2} \sqrt{3}$, and of the wattmeter at Z $\cos \phi° = 0$.

In other words, an individual wattmeter does not read negative till after its "power factor" has decreased to O, but one wattmeter of a three-phase system will read negative when the power factor of the *system* is below .50.

In the case cited by Mr. Stratton, though the "power factor" of one wattmeter was below .50, that of the system, was above .50, and hence neither wattmeter recorded a negative value.

There seems to be some discrepancy in the ratio of watts recorded by the individual meters and the current flowing in the system.

If we assume the readings of the individual wattmeters to be $W_y = 8{,}000$, $W_z = 3{,}600$, then

*$\tau \phi = \sqrt{3} \frac{4{,}400}{11{,}600}$	$= .657$
Power factor $= \cos \phi$	$= .8355$
Wattless factor $= \sin \varphi$	$= .5495$
Apparent watts $= \frac{11{,}600}{.8355}$	$= 13{,}900$
Power component current	$= 11.2$
Wattless component current	$= 7.35$
Primary current	$= 13.4$

Assuming this last value of current to be correct, and making cor-

*See ELECTRICAL WORLD AND ENGINEER, November 23, 1901.

responding substitutions in the diagram the record of wattmeter at *Y* would be

$$I\,E\,cos\,\phi_y = 13.4 \times 600 \times cos\,3^\circ\,20' = +8000$$

and at *Z* would be

$$I\,E\,cos\,\phi_z = 13.4 \times 600 \times cos\,63^\circ\,20 = +3600$$

These are the values of watts recorded. Assuming them to be correct the remarks concerning the condition for obtaining a negative reading upon one meter apply equally as forcibly as before, since the power factor of the system is above .50.

ITHACA, N. Y. A. S. MCALLISTER.

To the Editors of Electrical World and Engineer:

Sirs.—The writer has noticed the peculiar results Mr. Stratton obtained in testing his three-phase induction motors, and believes the matter can be easily explained.

Mr. Stratton obtains the power factors apparently from the following formulæ:

$W_1 = I\,E_{13}\,cos\,\phi$, and $W_2 = I_2\,E_{23}\,cos\,\phi_2$ where W_1 and W_2 are the readings of the two wattmeters. This is not correct. For the two-wattmeter method on a three-phase system the formulæ are:

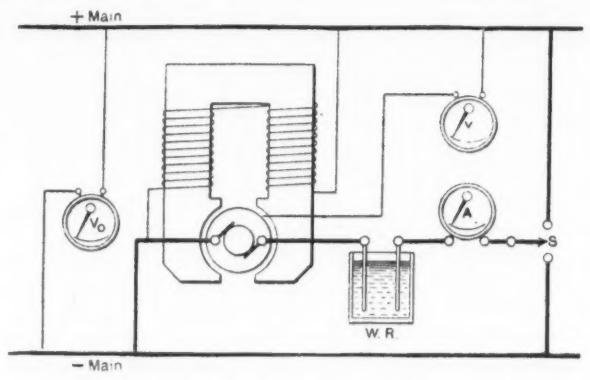
$W_1 = I_1\,E_{13}\,cos\,(\phi_1 - 30^\circ)$ and $W_2 = I_2\,E_{23}\,cos\,(\phi_2 + 30^\circ)$, where W_1 will be the higher reading instrument.

MONTREAL, CANADA. CHARLES BRANDEIS.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Testing of Motor Losses.—SUMPNER.—A paper read before the Birmingham section of the (Brit.) Inst. of Elec. Eng. He discusses three different methods which have the common feature that they are acceleration methods in so far as from the way in which a machine slows down under the retarding torque due to frictional and other losses, the magnitudes of these losses are deduced. In the first method the only apparatus required are an ordinary watch, a good speed indicator, and some means of applying to the machine a small measured retarding torque either mechanically or electrically. The time is taken in which the machine slows down from a given speed m to n, as read by the speed indicator; the loss of kinetic energy of the revolving mass in $a\,(m^2 - n^2)$, when a is a constant depending on the moment of inertia of the rotor. If the retarding torque is altered while the values m and n are the same, a can be determined. The retarding torque may now be altered by varying the excitation of the machine, and in other ways, so that the torque due to hysteresis and eddy currents can be separated from that due to friction. Moreover, the torque at different speeds can be determined. The mathematical formulas are given. The limit of accuracy is determined by the speed indicator. The second method described applies to large alternators working in parallel. The synchronizing apparatus can be used as the speed indicator by making use of the principle of beats. If the machines are running in synchronism, and power be shut off from one machine and its armature circuit opened the synchronizing apparatus will show more and more rapid beats. If the number b of beats occurring in a time t is counted, from the moment of opening the armature circuit, then $Tt^2 \div b$ is a constant quantity for any particular machine, where T is the retarding torque caused by the losses. The third method applies to a direct-current shunt machine, or an alternator provided with an exciter on the same shaft, or any machine which is run up to speed by means of a belted shunt motor. The method consists, as shown in the adjoining diagram, of using a suitable low-voltage voltmeter



TESTING OF MOTOR LOSSES.

to measure the difference between the voltage of the field magnet coils and the induced e. m. f. in the armature. The field magnet is permanently connected to constant potential mains, the armature being connected across the mains through a switch and starting resistance, the switch end of the armature being also connected to the corresponding main through a voltmeter provided with a key. When the desired speed is attained the armature switch is opened and the voltmeter key is closed. The reading of the voltmeter is a direct measure of the change of speed. The method then merely consists in observing the time interval taken for the voltmeter to change its deflection between two given values. When this method is applicable the speed readings can be very accurately taken. The only novelty in the suggestion of using a voltmeter as speed indicator arises from the special way in which it is connected. Instead of joining it up across the armature so as to indicate the total speed of the machine, it is connected so as to measure the difference between the constant voltage corresponding with the normal speed and the actual voltage due to the reduced speed. It is thus possible to use a sensitive voltmeter capable of indicating by a considerable deflection small changes in speed. This is a great advantage, for in this acceleration methods the time measurements can be much more accurately taken than the speed indications. Besides, it is desirable to make the measurements for a small percentage change in the speed. An account is given of tests in which this method was used.—Lond. *Elec.*, Feb. 7.

German Manufacturing Plant.—E. K. SCOTT.—An illustrated article on a recent visit to the Schuckert works. In the large machines the armature windings are not soldered to the commutators but are screwed to them. In several large machines the writer noticed a long, narrow slot, which was cut down the middle segment of the commutator so that the air could freely circulate from inside to outside. Great care is taken to bring the pole faces close together, and the pole tips are machined off to a sharp edge.—*St. R'y Jour.*, Feb. 1, and Int. Ed., Feb.

Alternating-Current Machinery for High and Low-Speed Frequencies.—BEHREND.—The first part of an illustrated article, in which he begins with a discussion of 60-cycle alternators. When driven by a slow-speed steam engine at 120 to 75 revolutions, it must have 60 or 96 poles, respectively. It is advantageous to place this large number of poles directly on the flywheel. The main difficulty is to devise a construction which gives, with a small amount of material, a stiff but narrow armature. The efficiency of such slow-speed, 60-cycle generators is very high and the heating very low.—*Elec. Rev.*, Feb. 15.

Speed Regulation of Direct-Current Motors.—SCHULZ.—A brief general discussion of the different methods by which the speed of a direct-current motor can be changed. The article does not seem to contain anything new.—*Elek. Anz.*, Jan. 26.

POWER

REFERENCE.

Air Brakes.—An illustrated article on the electric control of air brakes.—*Elek. Anz.*, Jan. 30, Feb. 2.

TRACTION.

Third Rail.—GUARINI.—A brief article on several third-rail installations in various countries. Recently the service on the Milan Varese line in Italy has commenced. The length of the line is not given. At present the ordinary service of steam trains has not been interrupted, but to these have been added 14 electric trains, i. e., seven in each direction, of 2 cars and 168 seats each. Direct current at 600 volts is used. Its motive power is supplied at present by a steam central station, but it will soon be furnished by a hydraulic installation.—Lond. *Elec. Rev.*, Feb. 7.

REFERENCE.

Lorain Surface Contact System.—A long illustrated description of the experimental line of the Wolverhampton municipal tramway, on which the surface contact system of the Lorain Steel Co. will be tried.—Lond. *Elec. Eng.*, Feb. 7.

Installations. Systems and Appliances.

Charging for Electrical Energy.—Esson.—A long reply to the critics of his former article. He carefully distinguishes between company and municipal undertakings. The aim in selecting a system of charigng by a company must be a commercial one—to make profits. The only result of the maximum demand system is to give long-hour consumers their electricity cheaper, but this, a flat rate with discounts, will answer equally well. Discounts, however, should be based not on the amount of electricity consumed, but should be given in respect of the class of customers supplied. Experience has taught what discount should be given to each of the few classes between which it is found necessary to differentiate. The flat rate system with such discounts amounts in practice to the maximum demand system without the maximum demand indicator. If, however, some indication of the maximum demand is advisable, the simplest is to take the number of lamps fixed as this indication; but "obviously it would be much better if the basis of the charge were not the number of lamps fixed, but the maximum number of lamps simultaneously in use, and this is where a recording indicator comes in. An automatic assessment from time to time of the number of lamps alight, frees the demand system from all difficulties. While the method of charging should be a matter of profits for a company, it should be a matter of principles for a municipal undertaking. He upholds his former proposition that in order to meet the standing charges of the electrical undertaking—the cost of getting ready the supply—a municipal tax should be levied on all the residents within the area served, the compulsory area to begin with, and the extended area as the undertaking expands.—Lond. *Elec.*, Feb. 7.

South London Electric Plant.—An illustrated description of this plant. The single-phase alternating-current system is used. There are 5 steam-driven, 3000-volt alternators, of together 3300 kw capacity. There are six feeders, supplying independent networks. Each of these high-pressure networks feeds a number of transformers in street boxes, and each of these again supplies a small local and independent low-pressure network. The high pressure feeders are all drawn into earthenware ducts, in which an ample number of spare ways has been provided. The low-pressure mains are laid in bitumen on the solid system. The lamp connection is equivalent to 58,000 lamps of 8 cp, and there are a few motors in use. The general supply is given on the two-wire system at 220 volts. Energy for lighting is charged for at the flat rate of 10.5 cents per unit, and for power at 4 cents per unit.—Lond. *Elec. Rev.*, Feb. 7.

Wires, Wiring and Conduits.

Direct-Current Distribution Mains.—Ward.—An illustrated paper read before the Glasgow Section of the Inst. of Elec. Eng., giving "practical notes on continuous-current distributing mains." He says that while mains break down owing to faults in manufacture, and to mechanical injury, yet there is no form of destruction so difficult to contend with as the action of electrolysis, which commences where it is insufficiently guarded against, at the moment that the mains are made alive. The continual heaping up of moisture at the negative conductor, where exposed, tends to lower the insulation resistance between that conductor and earth, and especially in cases where the middle or neutral conductor on a three-wire system is deliberately earthed, minute currents tend to pass from the neutral conductor through the earth and on to the negative conductor, resulting in electrolysis. He discusses the construction of end boxes and earth plates, and the question of fusing feeders and networks. He describes at length the elaborate system which has been in use in Glasgow with the endeavor not only to keep the distributing system joined up throughout, but also to fuse as effectively as possible. From the point of view of central station efficiency he thinks that a triple concentric system can be maintained in a nearer state of perfection than a system consisting of single conductors, for the reason that, as a rule, any defect in insulation between the conductors rendering the main immediately useless necessitates repairs without delay, whereas with a system of single conductors small leaks may remain undetected for a considerable time, and have very destructive electrolytic effects upon the whole system. This applies especially to large systems, when it becomes practically an impossibility to take frequent insulation tests of each section of the system. He recommends the adoption of a triple concentric system with an insulating outer sheathing, laid on the solid system, in cast-iron or stout wooden troughs.—Lond. *Elec.*, Jan. 24, 31.

Some editorial notes are given on this paper. The advantages gained by fusing both feeders and distributors at Glasgow, are thought to have been gained at the expense of simplicity of apparatus. As typical of a large network in which no fuses are used, Manchester is noticed, where Wordingham's pillar distributors form a practical and effective means of disconnecting at street corners and dividing or isolating the network generally. By this system, however, a fault in one section will have a much more serious effect on the remainder of the network than with a well-dimensioned system of fuses in the network boxes. It is thought that Ward is unnecessarily alarmed regarding electrolysis. The lead covering of the cables on any network, whether continuous or alternating, high-pressure or low-pressure, should be connected through, and there should be no interruptions in its continuity. This done, there should be no danger from electrolysis. Even in solid systems in which lead-covered cables are used, the metallic continuity should not be interrupted.—Lond. *Elec.*, Jan. 31.

Fuse Wires.—Murdock.—A communication giving an account of experiments in which he determined the effect on the time of fusing, of altering the length of a fuse wire, the current being kept constant. The wire was held in terminals capable of being set at given distance apart, and the current kept constant by means of a lamp and water resistance. The results show the importance of making a fuse wire exceed a certain definite length in order that the time of fusing may be a minimum for a given current. No. 24 lead-tin fuse wire was used, the current was 13.3 amperes. For a length of 8 inches the time of fusion was 3 seconds; for 2 inches, 6.5 seconds; for 1 inch, 12.5 seconds; for 0.75 inch, 92 seconds; for 0.63 inch, no fusion. He then compared the time of fusion for vertical and horizontal fuse wire, No. 24 lead tin wire being used, the current being 13.4 amperes. For a length of 1 inch the time of fusion was 8 seconds for the vertical wire, and 11.5 seconds for the horizontal wire; for a length of 4 inches the time was 3.2 and 2.5 seconds, respectively. In the case of the vertical wire there is almost no visible heating, although horizontal wires of equal length glow brightly before fusing. The wires invariably break at the point of maximum tension. He claims that fuses should be designed so that for a given fusing current the time of fusing will be practically a minimum.—Lond. *Elec.*, Feb. 7.

Electro-Physics and Magnetism.

Heat Energy.—Swinburne.—An abstract of a Brit. Phys. Soc. paper on "The factors of heat." He remarks that while it is generally customary to split energy into an intensity factor and a quantity factor, this is not usual with heat. He builds up a system of dividing heat into factors upon the strict model of electrical energy, i. e., he assumes a heat quantity-factor analogous to electricity (coulombs), and a heat intensity factor analogous to electric potential (volts). The first he calls "posot," the latter "tasis." Tasis is of the dimensions of the square root of temperature. "Conductivity of posot follows Ohm's law, and the capacity of a body for posot is constant." In the discussion which followed, Everett, Bryan, Donnan and Gray thought the proposed changes involve loss of simplicity without compensating advantages. Donnan said that the entropy function is good enough for developing a consequent science of thermo-dynamics. There is also a long editorial in which it is pointed out that the temperature and the heat capacity are the natural fundamental factors of heat. Heat is sui generis among all the forms of energy; the operations of all forms of energy other than heat involve the irreversible transformation of some of the energy into heat, while on the other hand, even irreversible processes of heat transference do not dissipate heat energy into any other form of energy from which it cannot return to the condition of heat. Heat is "the scrap-heap of the universe's energy."—Lond. *Elec.*, Jan. 31.

Nickel Amalgam.—Wuensche.—An account of an investigation of the magnetic behavior of nickel amalgams. He is strongly of the opinion that in the case of nickel amalgam a chemical combination of nickel and mercury must be assumed, as it shows an extraordinarily low magnetization. Sometimes amalgams containing little nickel

are found to be more magnetic than amalgams containing much nickel.—*Ann. der Physik,* No. 1; abstracted in Lond. *Elec.,* Jan. 31.

Crystallization Under Electrostatic Stress.—HEYL.—An account of experiments based upon the thought that if crystals were allowed to form from solutions subjected to strong and intermittent electrostatic stress, the crysals might, when large enough to be observed, bear some birthmarks which might be interesting or possibly valuable. A change in the interfacial angles seemed the most likely effect, and an alteration of density was deemed possible. These effects were looked for, and a salt sensitive to slight mechanical disturbances, mercuric iodide, was used as an indicator; but no effect was found. This negative result may be thus stated: Any molecular forces called into play in a solution under electrostatic stress are not comparable with the forces of crystalline attraction.—*Phys. Rev.,* Feb.

Kerr Effect.—SCHMIDT.—An account of an experimental investigation. The liquids which exhibit the Kerr effect may be divided into two classes, corresponding respectively to positive uniaxial crystals and to negative uniaxial crystals. The intensity of the electro-optic effect of the dielectric, i. e., the difference of the retardations of the ordinary and extraordinary rays, reduced to unit thickness of dielectric, is proportional to the square of the difference of potential and to the electro-optic constant. He has studied a number of liquids, including carbon bisulphide, chloroform, amyl compounds, benzol compounds, a number of alcohols and water, the liquid in the condenser of reference being "cumol" free from "terpene." Two remarkable results were obtained. One of these is the intermediate value obtained in the case of water, which in other electrical qualities is very irregular. The other is the enormous double refraction of nitro-benzol, viz., 60 times that of carbon bisulphide, which hitherto passed for the substance showing the greatest Kerr effect.—*Ann. der Physik,* No. 1; abstracted in Lond. *Elec.,* Jan. 31.

Atmospheric Electricity.—LINKE.—An article on the influence of ascending and descending currents of air upon the course of the atmospheric potential. According to modern researches, the earth has a negative charge. The atmosphere contains more positive than negative ions in the lower strata, but in the upper strata they are about equal in number and much more numerous. Any conductor, such as a drop of water, moving upwards in the atmospheric field, must acquire a free negative charge, whereas it must become positive on descending. When a number of drops coalesce, the charges and volumes are simply added, but the capacity of the resultant drop only grows with the cube root of the volume. Ascending clouds in which this process takes place may, therefore, produce a high negative potential, more highly negative than that of the earth even, and may thus produce a reversal of the ordinary potential gradient. He quotes a balloon observation in which a stratum of mist had a positive charge at an elevation of 1000 meters, and a negative charge when it reached an elevation of 1800 meters. A lightning flash at high levels enables the layer to assume the surrounding potential, and a sudden fall would then lead to another discharge.—*Ann. der Physik,* No. 1; abstracted in Lond. *Elec.,* Jan. 31.

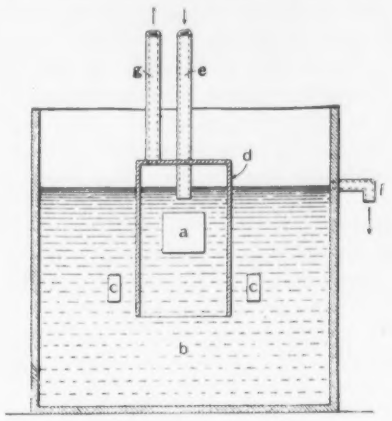
Dielectrics Subjected to High Potentials.—SHEARER.—A long account of some experiments on the behavior of dielectrics when subjected to high potentials. He concludes that all the observed changes may be readily accounted for without reference to anything other than heat and the slight distortions due to an unsymmetrical distribution of charge. It seems that the production of changes of form and dimensions in matter by purely electrostatic strain is extremely improbable.—*Phys. Rev.,* Feb.

REFERENCE.

Vacuum Discharges.—LEHMANN.—An account of a long investigation of the discharges through very large and wide tubes. He used a tube composed of two air-pump bells cemented together, thus obtaining a space 65 cm. long and 32 cm. broad.—*Ann. der Physik,* No. 1; abstracted in Lond. *Elec.,* Jan. 31.

ELECTRO-CHEMISTRY AND BATTERIES.

Bell Process for the Production of Alkalies and Chlorine.—J. B. C. KERSHAW.—An illustrated article on this new commercial process, the characteristic feature of which is the absence of a diaphragm and the separation of the anode and cathode parts of the electrolyte by means of gravity. The anode is surrounded by a "bell" ("glocke"), which gives the process its name. The adjoining diagram is a diagrammatical section of the cell, in which *a* is the anode, *c* the cathodes, *d* the bell, and *e* and *g* the feed and gas exit pipes, respectively, to the anodic compartment. The cell is filled with brine. In the anodic department chlorine is formed, in the cathodic compartment caustic alkali. The separating zones between the two parts of the electrolyte tends to rise upwards in the bell while the electrolysis proceeds, and would finally reach the anode. To prevent this, fresh brine solution is admitted through the pipe *e* into



SECTION OF GRAVITY CELL.

the anode compartment either continuously or at short intervals of time. At the same time the caustic alkali solution leaves the cathode compartment through the overflow pipe *f*. The admission of brine solution through *e* is regulated so that the speed with which the anode liquid passes downwards, equals that with which the alkali tends to pass upwards (which is closely related to the coulombs passed through the cell). In this way it is possible to maintain constant the level of the zone where the anode and cathode liquids meet, without in any way destroying the line of demarcation. The advantages claimed for this type of cell, as compared with the other forms in actual use at the present time, are: A current efficiency of 85 to 90 per cent, and a cathode liquid containing 100 to 150 grams caustic alkali per liter, without the use of mercury or of diaphragms, a greatly increased life of the carbon anodes, with decreased cost of operation and increased purity of the chlorine produced. A reduction in the working costs of the cell and process, owing to very simple nature of the cell and its method of operation. Ordinary thick lamp carbons are used as anodes, and are stated to have a life of 1¾ to 2 years. He has received the following official information regarding the cost of operation from the Austrian firm which operates the process commercially after having worked it out during the years 1893 to 1899. The capital outlay upon a plant utilizing current from four 600-hp generators, and producing 14,000 kgr., 90 per cent caustic potash and 21,600 kgr. bleaching powder per day is $750,000, the working capital $50,000; hence total capital $800,000. The total working costs per day are $1,857. Taking the current values for caustic potash and bleaching powder, the margin between actual costs and sales values of the daily products works out to $1,185, a sum more than ample to cover all manufacturing contingencies incidental to the conduct of the process. If caustic soda is made instead of caustic potash in the same plant, 9200 kg. caustic soda (72 per cent oxide of sodium) and 21,600 kgr. bleaching powder are produced per day, the total working cost per day is $1,074; but taking current prices for the products, the margin between daily actual costs and sales value works out at only $170. This is the reason why the owners of plants have preferred to decompose potassium chloride rather than the sodium salt. The market for caustic potash is, however, a restricted one. The bell process is in operation at one Austrian and three German plants, the total number of bells in operation at the end of 1901 being given as 24,000. "It is noteworthy that it is by careful attention to the feed of the electrolyte to the anode compartment of the cell that a type of cell which failed in the hands of the Electro-Chemical Company at St. Helens, Lancashire, in 1899, has been converted into a practical industrial success."—Lond. *Elec.,* Feb. 7.

Ionization, Ionic Velocities and Atomic Sizes.—SUTHERLAND.—A highly theoretical paper in which he discusses several "gaps" in the electrolytic theory of ions. He first deals with the cause of ionizations, and says that exceptionally high dielectric capacity, high-power of ionization, and marked tendency to molecular association, are three effects traceable to the same cause, which he proposes to call the

latent or potential valency of certain atoms. He suggests using certain well-known musical signs, the sharp, the flat and the natural signs, for distinguishing the two kinds of electrons from another and from the "neutron." By means of this notation he shows how the high dielectric capacity, molecular association, and ionization in water may be explained as consequences of the latent or potential valency of oxygen. A radical with electric charges, yet not an ion, because its charges are equal and opposite, he proposes to call a stion; the neutron and stion differ as do the electron and the ion; the neutron and electron are the molecule and atom of electricity, the stion and the ion are atoms of matter with associated electrons. Those substances which fail to conform to Maxwell's relation between dielectric capacity and index of refraction, when the dielectric capacity is measured electrostatically, fail because they contain stions which are doublets of exceptionally large electric moment. The second part of the paper deals with the question why Ostwald's law (the relation between dilution and degree of ionization) which was found to be true for over 200 weak organic acids dissolved in water, fails completely for ordinary binary electrolytes. He thinks that Ostwald's formula applies to weak acids because many of these are known to polymerize. Acetic acid is probably diacetic acid, and when dissolved in water is partly dissociated into mono-acetic acid, which is practically all ionized. This law for acetic acid is probably the expression for equilibrium between diacetic acid and the products of its dissociation, namely, mono-acetic acid. A similar explanation will apply to all his cases of weak acids. This is different with ordinar binary electrolytes; but he emphasizes that it is first necessary to have an experimental investigation of dielectric capacity in solutions, before we can determine ionization satisfactorily. "The complete theory of the ionization of the binary electrolytes, in aqueous solutions is more complicated even than it has been hitherto supposed to be." The third part of the paper deals with ionic velocities and absolute sizes of atoms. He deduces the ionic velocities from the other physical properties of the atoms, and shows the possibility of using them as a definite means of calculating the absolute sizes of the atoms. For the radius of the Li atom he gets 0.000000002 cm. The process of calculating the size of a molecule from its observed ionic velocity might prove helpful in the case of large organic ions such as physiologists have to deal with, for the molecular weight could be estimated from the size when other recognized methods of determining it fail. Incidentally, he mentions that the high mobilities of the H and OH ions may be explained as being due to the fact that these are the ions of water itself, and that these two ions have their real ionic velocities largely increased by a sort of Grotthus chain action, whereby an H or an OH instead of passing through the space of a water molecule, which is in front of it, simply combines with part of the molecule and liberates the other part at the other side, so that the same effect is produced as if the ion had traversed the space of the molecule with a higher velocity than the true ionic velocity.—*Phil. Mag.*, Feb.

Dissolution of Metals.—AUREN and PALMAER.—An abstract of a paper in which they say that the law of mass action cannot be applied to calculate the velocity of dissolution of zinc in acids, as the values so calculated do not agree with the experimental results. They consider that the dissolution is purely electrolytic, and occurs solely as a result of local currents. To this is due the slow velocity of dissolution of pure metals. On this assumption an expression is deduced for the rate of dissolution of a metal in acids of any concentration, the expression, however, involving an unknown quantity, the resistance capacity. This may, however, be deduced from one set of determinations and the velocity of dissolution under other conditions then calculated. The values so obtained were found to agree well with those determined experimentally. The temperature coefficient between 10 degs. and 50 degs. was found to be in general about 1.5 to 2 per cent per degree. This is far smaller than the usual temperature coefficient of a chemical reaction, but is approximately that of the increase of e. m. f., a result in accord with the theoretical views.—Lond. *Elec. Eng.*, Feb. 7.

Lead Storage Battery.—An account of tests of a new lead storage battery devised by Ricks. The feature is that the active material—lead peroxide and spongy lead—is absolutely detached from the metallic lead plates which collect and conduct the current. There is no attempt made to cause the one to adhere to the other, and, therefore, the usual trouble caused by the peroxide working loose, does not occur. The foundation for the active material is a non-conductive plate, such as ebonite or celluloid, with which it is possible to secure firm union, and which at the same time is less rigid and heavy than the usual lead grid. The active material in granular form is cemented and pressed on to the plate on both sides, and it is stated, adheres so firmly that it can scarcely be detached without breaking the plate. The lead-conducting plate is very thin, and is pressed by springs against the outer face of the active material, so as to be in intimate contact with a part of its surface. Holes are cut in the lead plate to facilitate the circulation of the electrolyte. The length of the plate is so great that it serves for a positive electrode in one cell, and a negative electrode in the next, the lead being bent over, and, therefore, does not need to be soldered or burnt between adjacent cells. The tests included several small batteries. In the first the active material was spread to a thickness of 0.17 inch on celluloid plate 0.02 inch thick, and measuring 7.7 by 6.3 inches. The lead-conducting plate was 0.02 inch thick, the total weight of cell was 4 lbs., and 30 ampere-hours were obtained in six hours at an average e. m. f. of 1.9 volts, giving 57 watt-hours, i. e., 14 watt-hours per pound of cell. Another cell of different dimensions and weighing 15.76 lbs. gave at the rate of 6 to 7 amperes, 130.6 ampere-hours at 1.8 volts average, equal to 245 watt-hours, or 15.6 watt-hours per pounds. In two other cells even 19.5 watt-hours per pound and 20.8 watt-hours per pound were obtained. (These results regarding watt-hour capacity are exceedingly good for a lead cell.)—*Centralblatt f. Accum.;* abstracted in Lond. *Eng'ing*, Feb. 7.

REFERENCES.

Rotation of Electrolytes in Magnetic Fields.—DRUDE.—Some notes on experiments made by Urbasch, who has shown that an electrolyte placed in a suitable magnetic field, shows rotation phenomena, when chemical processes or diffusion takes place in it. The present author points out that in order that these phenomena take place, it is essentially that at the same time an electric current flows in the electrolyte.—*Zeit. f. Elektrochemie*, Jan. 30.

Ions and Electrons.—GARRARD.—The first part of a general summary on "Recent development of the atomic theory and its connection with light and electricity."—Lond. *Elec. Rev.*, Feb. 7.

TELEGRAPHY. TELEPHONY AND SIGNALS.

Earth Telephony.—DUCRETET.—A description of a "Remarkable and somewhat mysterious new ssytem of telephoning without wires." He describes it as an extension of the geo-telegraphic experiments made in 1876 by Bourbouze. The transmitter consists of a microphone in circuit with a battery and two earth plates a few yards apart, with a hollow space formed by thick masonry between them. At the receiving end there is a vertical shaft, partly of cast iron, communicating with the catacombs of Paris. A metallic sphere, 8 cm. in diameter, lines on the dry soil of the catacombs and is attached to an insulated wire leading up through the shaft. This wire is attached to one terminal of an ordinary telephone whose other terminal is attached to the cast-iron shaft. Under these conditions anything spoken into the microphone, is exactly reproduced in the telephone, and without the secondary noises which are heard in ordinary wire telephony. It follows that the interrupted earthing conductor must somehow separate the outward and return currents, and thus form a complete circuit. The author does not state the distance between the stations, but mentions having succeeded in worknig an electric call bell at the receiving station on the same system. All action ceases when the sphere is lifted off the ground, and is restored on lowering it again. Further experiments are being made at different distances and with various earthing devices."—*Comptes Rendus*, Jan. 13; abstracted in Lond. *Elec.*, Feb. 7.

Wireless Telegraphy.—BRAUN.—An illustrated lecture on his system of wireless telegraphy, which has been noticed before in the Digest. He discusses chiefly his transmitter, and especially that arrangement in which the poles of an air-gap are connected to the inner plates of two condensers, while the outer plates are connected together by an inductive circuit, and besides are connected, one to the transmitting wire, the other to earth. This latter connection to earth was formerly thought to be necessary, but may be replaced by a wire of a length equal to the transmitting wire. This arrangement gives strong, pure, undamped oscillations. He proves experimentally that the waves are pure and increase their amplitude gradually by means of resonance.—*Phys. Zeit.*, Jan. 1.

Wireless Telephony in France.—An illustrated note on experiments made by Maiche. The results of the tests with an improvised apparatus and a current of .003 ampere at 8 volts, is given as fol-

lows: "At 1500 meters conversation was transmitted as distinctly as by the best ordinary telephony system; at 4 kilometers speech was still very distinct, but seeming to have arrived at the limit of perceptible intensity; at 7 kilometers, vibrations of the telephone plate sufficiently distinct to allow of Morse signals being transmitted with the utmost regularity. The transmitting apparatus used by Maiche consists, besides the source of electricity, of an improvised microphone and an induction coil wound in a special way. In the case of transmission of Morse signals, a key and vibrator are substituted for the microphone. In both cases the receiver was a sensitive telephone. The connection to earth consisted sometimes of two electrodes immersed in water, and sometimes of electrodes embedded in damp earth. The two electrodes at each station were connected by an insulated wire, which formed a basis on which was connected, according as required, the receiver or the transmitter."—Lond. *Elec. Rev.*, Feb. 7.

REFERENCES.

Telephone Exchange.—The first part of a well illustrated description of the National Telephone Company's new Battersea exchange. It has a lamp signal switchboard, working on the Kellog central battery system, the only one of its kind at present in Europe. It embodies a central station system of the latest type, but on somewhat different lines to the Western Electric Company's system.—Lond. *Elec.*, Feb. 7.

Underground Telephone Wires.—An illustrated description of an air-tight conduit, devised by Morten and Kenney, for placing telephone wires underground.—*Tel. Mag.*, Jan.

MISCELLANEOUS.

Machine Tools.—BATHURST.—The conclusion of his illustrated serial on machine tools at the Glasgow exhibition, with special reference to the requirements of dynamo and motor manufactures. He deals with side-planing machines and key-way cutting machines. In conclusion he says that even when the works of the English manufacturer are equipped with the best labor-saving, most accurate and most efficient types of machine tools, there is still a great disadvantage to overcome. His experience is that "generally speaking, a greater interest and intelligence is manifested by the American workman over that shown by his English confrere, because the American workshop is not so bound down by trade unionism to keep the individual output of the best man in the shop down to the level of the man of mediocre calibre." He recommends encouraging piece work in preference to time work.—Lond. *Elec. Rev.*, Jan. 31.

Tide Indicator.—SCHERMERHORN.—A paper, read before the Eng. Club, of Philadelphia, in which he describes an electrical tide indicator. The rise and fall of the water level is used to complete electric circuits which, through the intervention of electromagnets, communicate the motion to the indicator arm and device by which the required information concerning the height and character of the tide is displayed to the public. An ingenious device shows whether the tide is rising or falling. The apparatus is in use.—*Proceed. Engin. Club of Phila.*, Jan.

Light Treatment.—BANG.—An article on a new electric arc lamp for therapeutical treatment. The therapeutically active rays are the blue, violet and ultra-violet rays. He has obtained a practical lamp by using instead of carbon for the electrodes, metals of suitable spectral properties, as, for instance, iron, the spectrum of which is very rich in the desired rays. He cools the electrodes by water, either by making them hollow and letting a current of water pass through, or by making larger lamps and placing them in water. The bactericidal power of the rays given out by this lamp is said to be very great.—*Jour. Phys. Therapeutics;* Lond. *Elec. Rev.*, Jan. 17.

REFERENCES.

Celestial Explosions.—MAXIM.—An illustrated article on celestial explosions and their relation to electrical phenomena.—*Elec. Age*, Jan.

Science Abstracts.—The index to Vol. 4, 1901, contains a list of 133 scientific and technical journals, with the price and the name of the publishers.—*Science Abstracts*, 1901, Index.

Twenty Years of Electrical Development.—A general illustrated review by Child of the development of electrical industries from 1882 to 1902; also illustrated articles, by Elihu Thomson and Weeks, on electric lighting 20 years ago and since; by Stanley, on the beginnings of alternating-current engineering; by Sprague, on some personal reminiscences on electric railways; by Lockwood, on telephony 20 years ago and to-day; by H. A. Reed, reminiscences of an old-time telegrapher.—*Elec. Rev.*, Feb. 15.

New Books.

COMPRESSED AIR. Its Production, Uses and Applications. By Gardner D. Hiscox, M. E. New York: Norman W. Henley & Co. 822 pages, 40 tables and 545 illustrations. Price, $5.

The purpose of the author in the preparation of this work has been to provide a comprehensive manual for the engineer who is concerned with the use of compressed air in any of its many applications as found in modern engineering practice. To this end the subject is treated historically, theoretically and practically. The theoretical treatment comprises the usual discussion of the laws of isothermal and adiabatic expansion and compression with the thermodynamics of the various operations involved, together with tables, diagrams, formulæ, etc.

The practical side of the treatment comprises extended discussion of the applications of air in the useful arts in all forms from a high vacuum to its liquid form. The transmission of power by air, air compressors, air motors, air tools of various kinds, the air blast, railway appliances, refrigerating machines, etc., etc., are treated in extended form and illustrated freely with excellent diagrams and cuts.

Scattered through the work are found some 40 tables of the physical properties of air as required in its various applications in engineering work. A list of the patents on compressed air from 1875 to date is also included.

Taken as a whole, the work seems well adapted to fulfill its purposes. It represents the results of long experience and contact with the subject and the accumulation of many years' study of the useful applications of compressed air. The illustrations are especially plentiful, and while few of them seem to have been made for the book primarily, yet they serve to illustrate the subject in a very satisfactory manner.

In the general discussion of the subject will be found a large amount of information put in such form as to readily serve the purposes of the engineer and student. The size of the book and the diversity of topics treated shows well the extent to which air enters as a useful factor in modern engineering and manufacturing enterprise.

Excellent as is the make-up of the book generally it is to be regretted that the publishers saw fit to face the title page with a full-page advertisement of pneumatic hose. The introduction of advertisements in technical treatises is, leaving aside other aspects, unfair to the author, for the reader may connect a favorable reference in the text with the paid advertising notice appearing elsewhere in the book, and those manufacturers who have not responded favorably to solicitations from the advertising agent would be apt to place an unwarranted construction on any passage dealing unfavorably with a point or points involved in his apparatus.

Directory of Electrical Societies, Etc.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Next meeting, Chicago, June 18, 1902.

ASSOCIATION OF THE EDISON ILLUMINATING COMPANIES. Next meeting, September, 1902.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Quebec, June 11, 12 and 13, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, September, 1902.

NATIONAL ASSOCIATION OF MANUFACTURERS. Next meeting, Indianapolis, Ind., April 15, 16 and 17, 1902.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 25, 26 and 27.

OHIO STREET RAILWAY ASSOCIATION. Next meeting, June, 1902.

OLD-TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILI-

TARY TELEGRAPH CORPS. Next meeting, Salt Lake City, Utah, September, 1902.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, October, 1902.

SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION. Next meeting, San Antonio, Tex., April 18-21, 1902.

Illuminations for Prince Henry at the Opera.

Among the entertainments given to Prince Henry of Prussia during his stay in New York last week was a gala performance at the Metropolitan Opera House, which was on an unprecedented scale of magnificence, with prices in keeping, the charge for a single seat in the orchestra being $30. To justify such prices, Mr. Maurice Grau not only felt constrained to put on all his operatic stars in one night, but to go in for elaborate decorations, and to supplement these by illuminations of a very unusual and expensive character. Outside the Opera House, some excellent effects were obtained, with eagles, streamers, shields, etc., in incandescent lamps, and high above all the Emperor's new yacht "Meteor" outlined in white light. But it was inside that the Opera House wore its most striking and original aspect. Aside from the decorations to the approaches and the royal box, the whole auditorium was draped in smilax from the floor to the dome, and set in this around the various tier fronts, were innumerable big bouquets of choice flowers. It was, however, upon the dome and the proscenium that the extra lighting effects were chiefly concentrated, and there, thanks to the marvelous manner in which the "Elblight" system lends itself to rapid structural work, Mr. Spaulding, the manager of the National Electric Improvement Company, was able to do a really startling piece of spectacular work —as daring as it was successful. The contract taken by Mr. Spaulding called for 8500 lamps in all, and there were literally no signs visible of this stupendous job from the auditorium before the Sunday preceding the Tuesday of the performance. Special arrangements for current had also to be made, the service given by the New York Edison Company representing fully 1500 amperes. The lamps used were all 4 cp, 20 watts, and all of them stabbed into the "Elblight" cables.

The huge dome had an open canopy of smilax, and back of this were long "Elblight" spans of cable carrying green and white lamps, the strings running from the central electrolier out in every direction to the four walls. The building, it will not be forgotten, covers a whole big city block. Here there were no fewer than 1500 lamps, and the effect was, indeed, beautiful. But the piece de resistance was the proscenium, with its arch, sides, drop curtain and all. This proscenium is one of the largest in the world, and the whole front and width, some 60 or 70 ft. square, was a mass of green smilax in front of the regular drop curtains. Closely associated with the green drapery were "Elblight" cables again, carrying no fewer than 6000 lamps, of which 4500 were in the movable curtain, the lamps all being either green or white. By an ingenious system of tackles, the curtain could be raised and lowered as though it were a permanent part of the proscenium fittings, and this was no joke, for it weighed one ton, and, of course, required several men to raise and lower it from the flies. All told, the weight of the curtain and its adjuncts at the sides and on top of the proscenium arch weighed not less than three tons. In order to be sure of smooth operation and to obtain distinct effects, Mr. Spaulding installed telephonic connection between the proscenium and the ceiling, so that orders could be given and carried out instantaneously at the respective switchboards.

It will, we think, be admitted that for a large and swift installation this will take the record. Those of our readers who were at the famous Institute-Marconi dinner will recall the brilliant effects obtained there by Mr. Spaulding, and will readily appreciate that here they were intensified manifold. All who saw them on the gala night were delighted, and they remained until the following Thursday to please successive audiences, when the whole paraphernalia was stripped down as rapidly and as easily as it had been installed. The word "easily" is used in a relative sense, however, for it is not conceivable that with any other appliances the work could have been carried out. The incidental trimming of the approaches to the royal box and the corridors, with some hundreds more of lamps in the same manner, deserves mention, but alongside the other achievement was taken very much as an insignificant matter of course.

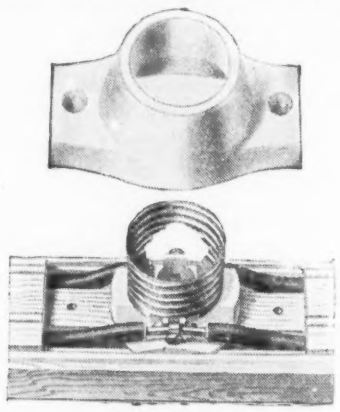
New Electric Heaters and Rheostats.

The McGuire Manufacturing Company, of Chicago, has added an electrical department to its plant, for the manufacture of rheostats and heaters. The resistance used is a composition of carbon and graphite. Electricians have long looked upon this material with favor for resistance, but the difficulty of associating the carbon with metallic connections has never been overcome so far, as to give satisfactory results. Carbon connections are used, which make a perfect contact and a uniform resistance not affected by age, temperature or dampness. A much larger radiating surface is obtained, thereby causing a much greater dissipation of heat. This greater radiating surface allows the carrying of an unusually large overload. There is no oxidation from any cause, and fusing from overload is entirely obviated, while no expansion, sagging, or loosening of parts takes place to cause short circuit. There is also claimed for this construction perfect insulation between the box and the resistance material, preventing leaking through the insulation when moist, thus completely avoiding the causes of grounding.

The McGuire Company states that before buying the patents covering these features, it assured itself by a most thorough investigation. The apparatus is already in use in the plants of some of the largest electrical concerns in the country, among them some who have been handling the ordinary rheostats in the commercial way for years. The new Tribune Building, of Chicago, and its printing presses, will be equipped with these rheostats. The services of the patentee of the apparatus, Mr. Max C. Krueger, have been retained by the McGuire Company. Mr. Krueger is an engineer of experience in electrical lines, and a graduate of the Polytechnic College of Berlin. He served his apprenticeship with the Siemens & Halske Company, of Berlin, later working for the same company in London and then in Chicago.

A Simple Receptacle.

The accompanying illustrations show the "P—K" Fielding moulding receptacle, manufactured by the H. T. Paiste Company, Philadelphia, Pa. It is of the Edison type, and measures 3 inches long,



FIGS. 1 AND 2.—RECEPTACLE PARTS.

2 inches wide and 2½ inches high over all. As shown in Fig. 2, it is intended for use on mouldings. All that is necessary to be done to apply it is to saw off a short length of the moulding cover, remove the insulation from the wires and connect the receptacle. The cap (Fig. 1), after being screwed down, holds the receptacle firmly in

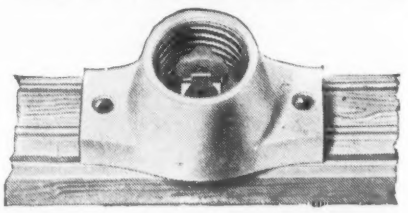


FIG. 3.—RECEPTACLE COMPLETE.

place. The cap itself forms the base, as seen in Fig. 3, which shows the receptacle complete, in place.

The easy access and application of this device are its principal advantages, besides its compactness. It is made of glazed porcelain, and altogether is a very handy accessory.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was obtainable with comparative freedom, the closing quotations being 3½@4 per cent for 30 to 90 days, 4@4½ per cent for four, five and six months. The stock market throughout the week was dull and heavy, and the public continued to buy investments, while bonds were strong. Large interests, however, supported prices, and bears seemed timid about attacking the market. The steel stocks were strong and had good support. Many inactive railroad specialties and cheap stocks of the same class were the objects of manipulation, and were marked up as to price. The traction stocks were stronger, there being considerable manipulation in Brooklyn Rapid Transit with renewed talk regarding the possibility of closer relations between the company and the Pennsylvania for control of the Manhattan interest. Amalgamated Copper was rallied on the shorts. Brooklyn Rapid Transit closed at 64, being a net gain of 2¼ points, 101,950 shares of stock being sold. General Electric made a big jump and closed with a net gain of 7 points, the extreme quotations being 290, the lowest, and 298, the highest; 9850 shares of this stock changed hands. Metropolitan Street Railway closed with some weakness at 168¾, a net advance of ⅛ point; the stock fluctuated within narrow limits all through the week, the highest figure reached being 170¼ and the lowest 167½. The sales were 24,425. Western Union remains unchanged at 90½, the sales being only 1390. Westinghouse Electric, common, closed at 178, a net gain of 4 points, and do. 1st pfd. at 182, a net gain of 2 points. Following are the closing quotations of March 4:

NEW YORK.

	Feb. 25.	Mar. 4.		Feb. 25.	Mar. 4.
American Tel. & Cable...	—	—	General Electric.....	293	296
American Dist. Tel.....	—	—	General Carriage.....	⅞	1⅛
Brooklyn Rapid Transit..	64½	63⅜	Hudson River Tel.....	—	—
Ches. & Pot. Telephone..	—	—	Metropolitan Street Ry...	168¼	167⅛
Commercial Cable.....	—	—	N. E. Elec. Veh. Tran...	½	½
Electric Boat.....	28½	28½	N. Y. Elec. Veh Tran...	13½	13⅜
Electric Boat pfd.....	45	45	N. Y. & N. J. Tel.....	—	—
Electric Lead Reduc'n...	1⅝	1⅞	Tel. & Tel. Co. America..	—	—
Electric Vehicle.....	1¾	2⅛	Western Union Tel.....	90¾	90¼
Electric Vehicle pfd.....	4½	4½	West. E. & M. Co.....	177	178
			West. E. & M. Co. pfd..	180	180

BOSTON.

	Feb. 25.	Mar. 4.		Feb. 25.	Mar. 4.
Am. Tel. & Tel.....	157¼	156	Mexican Telephone.....	2	2½
Cumberland Telephone...	—	—	New England Telephone.	140½	140
Edison Elec. Illum.....	—	—	Westinghouse Elec.....	87½	90*
Erie Telephone.....	—	—	Westinghouse Elec. pfd..	—	90
General Electric pfd.....	292⅜	—			

PHILADELPHIA.

	Feb. 25.	Mar. 4.		Feb. 25.	Mar. 4.
American Railways.....	64½	—	Phila. Traction.....	100	100
Electric Storage Battery..	—	—	Philadelphia Electric....	4¼	5½
Elec. Storage Batt'y pfd.	—	—	Pa. Electric Vehicle.....	—	—
Elec. Co. of America.....	6¼	6⅞	Pa. Elec. Veh. pfd.....	—	3

CHICAGO.

	Feb. 25.	Mar. 4.		Feb. 25.	Mar. 4.
Central Union Telephone.	—	—	National Carbon pfd.....	83½	84½
Chicago Edison.....	163	—	Northwest Elev. com....	37½	39
Chicago City Ry.....	216	215	Union Traction.....	13½	14⅞
Chicago Telep. Co.....	—	—	Union Traction pfd.....	—	50½
National Carbon.....	19½	20⅜			

*Asked.

PHILADELPHIA TROLLEYS.—The directors of the Union Traction Company, of Philadelphia, recommend the stockholders of the company to accept the offer of John Mack and his associates, now an unincorporated group, but later to be organized into the Consolidated Traction Company with a capital stock of $30,000,000, to lease the Union Traction Company for 999 years on the following terms: The new company to guarantee $1.50 per share for the first and second years, $2 per share on the third and fourth years, $2.50 per share on the fifth and sixth years and $3 per share for the seventh year, and for the other 992 years of the lease. The new company also to pay all fixed charges of the underlying companies, rentals, interest and taxes of every kind. The stockholders of the Union Traction Company to have the right to subscribe for 150,000 shares of the stock of the new company or one share for each four shares of their present holdings. The fixed charges of the new company for the first year will be nearly $8,000,000; license taxes, $1,029,963; fixed charges, $5,704,265; rental of Union Traction Company, $900,000; obtaining charter of new company, $75,000, to which must be added the tax on the $3,000,000 to be called on the new company's stock, or $5 a share. A collateral trust loan of $1,500,000 will be made by the Union Traction Company to take up the floating indebtedness of the company and pay all bills, so that the new company can start on July 1 without any floating obligation. This trust loan will be made by depositing some of the treasury stock of the Union Traction Company. The interest on this loan is to be paid by the new company until the loan is canceled. Just where John M. Mack and his associates were to profit by the transaction is elucidated by the statement that Mr. Mack and his associates have the right to subscribe to 450,000 shares of the new company's stock. These rights may be worth from $3 to $5 a share, so that, assuming the latter figure, Mr. Mack, without receiving one penny from the new company for the franchises, will be able to net for himself and associates $2,250,000.

COMMERCIAL CABLE.—The annual report shows gross $3,371,063, and expenses, $1,111,166; net, $2,259,897. After deducting bond interest and dividends of 8 per cent, the balance is $409,537. The previous surplus was $221,066, and after deducting $500,000 for the reserve fund, the present surplus is $130,603. The above gross is for the cable, with net from the land lines, while the expenses are for cable lines only. The general reserve fund now is $4,421,208, and the insurance fund $689,809. In addition to the Azores cable, etc., there were added to the land system 307 miles of poles, 14,966 miles of wire, and 96 new offices. The board of directors elected is as follows: John W. Mackay, James Gordon Bennett, Right Honorable Lord Strathcona and Mount Royal, G. C. M. G.; Gardiner G. Howland, Charles R. Hosmer, Colonel William Jay, Thomas Skinner, George G. Ward, Clarence H. Mackay, Sir William C. Van Horne, Albert B. Chandler, Edward C. Platt, Dumont Clarke. Dr. W. Seward Webb and Edwin Hawley were added to the board, which was increased from 13 to 15 members. The officers elected at the meeting of the board of directors are: John W. Mackay, president; Geo. G. Ward, vice-president and general manager; Charles R. Hosmer, vice-president; Albert B. Chandler, vice-president; Clarence H. Mackay, vice-president; Edward C. Platt, treasurer; Charles E. Merritt, assistant treasurer; Albert Beck, secretary, and John O. Stevens, assistant secretary.

SAN FRANCISCO TROLLEYS.—The plan that the syndicate headed by Brown Brothers & Co. is underwriting contemplates the purchase of the Market Street Railway and other lines in San Francisco. A corporation, called the United Railways Investment Company, of San Francisco, will issue $15,000,000 5 per cent cumulative preferred and $5,000,000 common stock. It will own the bonds, preferred and common stocks of the United Railroads of San Francisco, the stock and bonds of which will be $20,000,000. The latter company will furnish $1,600,000 cash for betterments and improvements, and will reserve stock to take up minority stock of lines, the control of which has been already acquired. The combined system has a mileage of 229. It earned last year $5,125,282 gross and $2,083,155 net.

DISTRICT TELEGRAPHS.—The American District Telegraph & Messenger Company was incorporated in Trenton, N. J., last week, with an authorized capital of $50,000 to operate lines of telegraph, a messenger service, and a system of electrical call boxes in New Jersey, New York, Pennsylvania and Delaware. The incorporators are: F. L. Blendinger, of Rutherford; C. S. Shivler, of Brooklyn, and J. C. Willever, of Millburn. The office of the company is at 76 Montgomery Street, Jersey City, and J. B. Bertholf, manager of the Western Union Telegraph Company's system in Jersey City, is the agent.

COLUMBUS (GA.) WATER POWER.—The annual meeting of the Chattahoochee Falls Company, owners of the Clapps factory property, just above Columbus, Ga., was held recently. The following officers were elected: President, George J. Baldwin, of Savannah, who is president of the Columbus Railroad Company; secretary and treasurer, A. A. Wilbur. L. H. Chappell remains general manager of the company. The company owns a splendid water power, and it is the the intention of the present stockholders to develop it as early as possible.

THE CANADIAN GENERAL ELECTRIC COMPANY, of Toronto, Ont. ,is about to issue $1,000,000 additional capital in common stock. This will make the capital of the company $3,000,000, of which $300,000 is preferred. Only about half a million of the new stock will be issued at present. The increase is to provide for the rapidly growing business of the company.

CONNECTICUT WATER POWERS.—Winsted (Conn.) dispatches state that the New Milford Power Company has increased its capital to $1,000,000, and is buying up all the water privileges on the Housatonic River.

STATEN ISLAND.—Three of the Staten Island trolley roads have been put in the hands of a receiver, it being the intention to bring them under one management in the reorganization.

CAMDEN & TRENTON RAILWAY.—One million seven hundred and fifty thousand dollars capital stock of the Camden & Trenton Railway Company, par $10, has been issued, and the old stock, par $100, stricken off. The company's bond issues consist of $750,000 first mortgage gold 5s, due Nov. 1, 1929, and $1,750,000 first general mortgage gold 5s, due July, 1, 1931. Of the latter issue, $400,000 are outstanding; $750,000 are reserved to retire the above $750,000 issue at maturity and the balance are reserved for any possible future extensions of the railway system within the cities of Trenton and Camden. The line of the Camden & Trenton Railway Company extends from the terminus of the Camden & Suburban Railway Company, to the city of Trenton, N. J., a distance of about 32 miles. The Camden & Trenton Railway connects at Trenton with the line of the Trenton & New Brunswick Railroad Company, affording connecting at New Brunswick over the Middlesex & Somerset and North Jersey Traction companies with all New York City ferries. In addition to the operation of the railroad, the Camden & Trenton Railway Company supplies electric light in cities and towns along its line.

UNITED RAILWAYS & ELECTRIC COMPANY.—At the annual meeting of the United Railways & Electric Company, of Baltimore, Md., the following officers were elected: President, John M. Hood; vice-president, George R. Webb; second vice-president and general manager, William A. House; secretary and treasurer, H. C. McJilton; auditor, N. E. Stubbs. The number of directors was increased from 9 to 11, and Messrs. H. C. Black, Alexander Brown, Francis E. Waters and J. M. Hood were newly elected. The annual report shows: Gross earnings, $4,718,295; operating expenses, $2,493,175; net earnings, $2,525,120; fixed charges, interest and taxes, $2,493,001; surplus, $32,118.

NEW YORK TRANSPORTATION.—Bunnell & Buchanan have issued a circular in which they say that the United States Express Company has closed a contract with the New York Transportation Company for the delivery of all express matter above Fifty-ninth Street. Passenger business has increased so much that it has been found necessary to open new stations in and about New York City and branches have been established at Buffalo and Newport. It is stated on good authority that net earnings for the quarter ending December 31, 1901, were over $40,000, which indicates that net earnings will be increased by $150,000 annually, making them 4 per cent on the stock.

CHICAGO EDISON STOCK INCREASE.—The directors of the Chicago Edison Company have decided to increase its stock by 6900 shares of $100 par value, the proceeds to be devoted to extensions and improvements. This will make a 10 per cent increase on the present outstanding capital of $6,900,000. The authorized capital is $10,000,000. The stock will be offered for subscription at par to stockholders of record April 22, 1902.

PENNSYLVANIA ELECTRIC VEHICLE.—A report from Philadelphia says: "The Electric Storage Battery Company, of Philadelphia, has practically acquired control of the Pennsylvania Electric Vehicle Company through the purchase of its stock."

DIVIDEND.—The directors of the Westinghouse Electric & Manufacturing Company have declared a quarterly dividend of 1¾ per cent on the preferred stock, payable April 1.

Commercial Intelligence.

THE WEEK IN TRADE.—In spite of the unfavorable weather conditions in many large sections of the country, current demand has been maintained at maximum, while spring business continued in large volume. The best reports as to spring trade come from the large jobbing centers of the East, West and Northwest. The Southwest continues to report somewhat unsatisfactory conditions. The immensity of consumption and the increased call from the rest of the world for supplies, constitutes the most remarkable evidence of the continued strength of demand and the abounding prosperity of the country as a whole. Bank clearings and railroad earnings show that, despite the rather poor reports from the South and Southwest, the business of the country, as a whole,, is still in excess of that of a year ago. Iron and steel are quieter on the surface, but consumption remains undiminished. Finished products show no diminution of demand, and the scarcity of steel is still the feature leading to predictions that the imports of this material will be very heavy. Short supplies of coke are complained of in the West, and furnaces are being banked for this reason, but the output of pig iron was larger last week than for some time past. Structural mills are filled with orders, most of them being five months' demand, and the same is true of other products, orders for which extend well up to the close of the year. Among the other metals, copper displayed some strength during the week, but the prices remained unchanged. The closing quotations were: Lake, 12⅜c. to 12½c.; electrolytic, 12¼c. to 12⅜c., and casting, 12⅛c. to 12⅜c. The business failures for the week, as reported by *Bradstreet's*, numbered 204, as against 228 the previous week, and 177 the same week last year.

JANUARY EXPORTS.—The export figures for the month of January and the seven months ending with January, 1902, just completed by the Treasury Bureau of Statistics, show an improvement in the outward movement of manufactures. In the month of January, 1902, the exports of manufactures amounted to $34,412,992, against $32,654,035 in January, 1901, and are the largest shown in any January, except 1900, when the total was $35,586,940. Compared with January, 1901, it will be seen that the figures show a gain of nearly $2,000,000 in the exports of manufactures. For the seven months ending with January the exports of manufactures are about $13,000,000 less than those for the corresponding period of the fiscal year, 1901. Indeed, manufactures for the month of January show greater evidence of activity in the export trade than any other class of our exports, being the only great class of exports which shows an increase in January, 1902, over January, 1901. Agricultural exports in January, 1902, fall $8,000,000 below those of January last year, while products of the mines, forests and fisheries are in January, 1902, slightly below those of January, 1901; while manufactures, as above indicated, are nearly $2,000,000 greater than those of January, 1901. In the three great articles in which manufactures had shown a decline during the past year—illuminating oil, copper manufacturers, and manufactures of iron and steel—there is a decided improvement, especially in illuminating oil and copper. In copper manufactures, the exports of January are valued at $3,965,622, against $3,790,364 in January of last year. The quantity exported has very largely increased, the total number of pounds of copper ingots alone (which form the bulk of copper manufactures) being in January, 1902, 32,085,041 lbs., against 22,270,030 lbs. in January, 1901, and 28,389,422 in January, 1900. For the seven months, however, the exports of copper manufactures are still about $9,000,000 below those of the corresponding seven months of the preceding fiscal year. The quantity of copper exported has greatly increased, though the value shows but a comparatively slight increase. The only item of importance in the list of manufactures exported which still shows a reduction is that of iron and steel, which falls in January, about $1,500,000 below the figures of January, 1901, being in January, 1902, $8,088,958, against $9,610,552 in January, 1901, and $10,218,628 in January, 1900. For the seven months the total exports of iron and steel manufactures were valued at $57,290,128, against $73,616,467 for the seven months ending with January, 1901, and $66,504,611 for the corresponding seven months of the fiscal year, 1900.

McKEESPORT TIN PLATE COMPANY, a new concern putting up works at Port Vue, near McKeesport, Pa., will have a very large plant, which will be operated throughout by electric motors, excepting the hot and cold mills. The output is to be between 1200 and 1500 boxes a day. There will be two electric generators of 150 kw each, driven by Harrisburg Ideal engine. The main building, containing 10 hot mills, will have two 15-ton electric traveling cranes, and the cold rolling and annealing building will also have two 15-ton electric traveling cranes, all four being furnished by the Whiting Foundry & Equipment Company, of Chicago. The plant will be under the direction of Mr. E. R. Crawford and Mr. J. E. Lauck, well-known tinplate manufacturers.

THE BUFFALO FORGE COMPANY, of Buffalo, N. Y., is building a large and interesting fan to be used for mine ventilation by the Modoc Coal Mining Company, of Gloucester, Ohio. This fan has a 250-inch housing of the three-quarter type, and is constructed throughout of steel plate rigidly stiffened and braced. The blast wheel or rotating element is of special design. It is to be driven by a direct-connected horizontal engine at a speed of about 150 r. p. m. The fan will deliver 125,000 cu. ft. of air per minute at ordinary working speed.

WESTERN ELECTRIC CAPITAL INCREASED.—Directors of the Western Electric Company have voted to issue $2,000,000 of stock at par to stockholders in proportion to their holdings. Each holder of four shares will receive one new one at par. The stockholders authorized an increase in the stock from $8,000,000 to $15,000,000 at the last annual meeting to be issued as the directors chose from time to time for improvements and extensions.

LOS ANGELES OFFICE FOR THE S. K. C. SYSTEM.—Messrs. John Martin & Co., Pacific Coast representatives of the Stanley Electric Manufacturing Company, of Pittsfield, Mass., have opened an office in the Douglas Building, Third and Spring streets, Los Angeles. They already have offices at San Francisco and Seattle, Wash., and have taken contracts for some of the largest power transmissions on the Pacific Slope.

GENERAL ELECTRIC NEW POWER PLANT.—Plans are reported to have been completed for a new power plant, to be erected by the General Electric Company in Schenectady, at a cost of $200,000. The station will be an extension of the one now in use, and will have an output of from 4000 to 6000 kw.

VARIOUS BUCKEYE ENGINE ORDERS.—The Buckeye Engine Company, of Salem, Ohio, 39-41 Cortlandt Street, New York City, reports recent receipt of orders for some 30,000 hp of engines to be installed for electrical purposes in various plants throughout the country. Foreign orders include a 17½-inch by 32½-inch by 27-inch cross compound engine, which will be shipped to Tokio on the order of the American electrical engineering and contracting firm of Bagnall & Hilles, of Yokohama. The Union Light, Heat & Power Company, of Covington, has called for two tandem compound engines. The Armstrong Electric Company, of Kittaning, Pa., is to be furnished with a tandem compound engine, 13 inches by 22½ inches by 21 inches. The Indianapolis Street Railway Company is to be forwarded a 32-inch by 60-inch by 60-inch cross compound engine for an extension of its plant. This is the second order received from the same source. The Canton Gas & Electric Company, of Canton, Ohio, is to be supplied with a 15¼-inch by 16-inch simple engine. The Central Union Depot & Railway Company, of Cincinnati, Ohio, has ordered three engines of simple type, 18¾-inch by 21-inch, 16½-inch by 18-inch and 11-inch by 14-inch. The United States Government has called for one 11-inch by 12-inch simple engine for the Kansas City Post Office. The Waterloo Gas & Electric Company, of Waterloo, Iowa, is to have a 12-inch by 22-inch by 16-inch cross compound, and a 16½-inch by 30-inch by 24-inch engine of the same type. The Cincinnati & Eastern Railway, of Cincinnati, Ohio, has ordered two tandems 18¼-inch by 26-inch by 33-inch. The Arrot Building, Pittsburg, is to be equipped with one 12-inch by 16-inch engine, and one 14¼ by 18-inch machine, both simple type. The National Soldiers' Home at Dayton, Ohio, is to be shipped a 21-inch by 22-inch simple engine. The Lunkenheimer Company, of Cincinnati, Ohio, has ordered a cross compound engine 14-inch by 22½-inch by 21-inch. The Muskegon Traction & Light Company, of Muskegon, Mich., is to be furnished with two 15½-inch by 28-inch by 30-inch cross compound engines, also one 18¾-inch by 36-inch by 30-inch of same type. The Lake Shore Electric Railway Company has ordered four engines each 18-inch by 32½-inch by 33-inch cross compound for installation in its new shops at Collingswood, Ohio. The Steubenville Traction Company, of Steubenville, Ohio, will be supplied with a simple type engine, 16½-inch by 18-inch. The Suburban Traction Company, of Cincinnati, Ohio, is to have two 22-inch by 40-inch by 36-inch tandems, and one 7¾-inch by 12-inch simple engine. The Edison Electric Illuminating Company, of Cumberland, Md., has requisitioned for a 20-inch by 22-inch simple engine. The Bureau of Public Lighting at Allegheny, Pa., is to be supplied with two 20-inch by 36-inch by 36-inch cross compound engines, one 16-inch by 28½-inch by 18-inch cross compound, and one 7½-inch by 12-inch by 12-inch vertical cross compound. The Buckeye Company is about to erect a new pattern shop which will represent a floor space of 1000 sq. ft.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Feb. 26: Antwerp—23 pkgs. material, $1,195; 1 pkg. machinery, $45. Argentine Republic—1 pkg. machinery, $74; 127 pkgs. material, $6,071; 3 pkgs. material, $150. Bilboa—2 pkgs. material, $100. British Poss. in Africa—8 pkgs. material, $993. British E. Indies—131 pkgs. material, $8,858. British Guiana—8 pkgs. material, $75. Bradford—46 pkgs. machinery, $15,395. Brazil—41 pkgs. material, $3,176; 22 pkgs. copper wire, $4,517; 23 pkgs. material, $1,084; 4 pkgs. material, $67. British Australia—52 pkgs. wire, $1,262; 19 pkgs. material, $1,440. British West Indies—26 pkgs. material, $632. Cuba—98 pkgs. material, $2,109. Chili—102 pkgs. material, $673; 1 pkg. cable, $140. Egypt—1 pkg. material, $90. French West Indies—1 pkg. material, $19. Genoa—29 pkgs. material, $7,450. Glasgow—4 pkgs. electric cable, $921; 5 pkgs. material, $1,000. Havre—3 pkgs. material, $900; 30 pkgs. material, $1,132. Hamburg—1 pkg. machinery, $45; 79 pkgs. material, $3,308. Huddersfield—20 pkgs. copper wire, $6,200. Ipswich—2 pkgs. copper wire, $100. Liverpool—70 pkgs. machinery, $11,230; 37 pkgs. material, $1,698; 242 pkgs. copper material, $13,500; 4 pkgs. motors, $1,630; 60 pkgs. copper wire, $5,842. London—388 pkgs. machinery, $38,319; 142 pkgs. material, $5,976; 25 pkgs. manufactures of copper, $625; 121 pkgs. copper wire, $12,896; 28 pkgs. electric cable, $8,840. Market Harborough—3 pkgs. wire, $225. Mexico—98 pkgs. machinery, $25,688; 7 pkgs. material, $54. Manchester—216 pkgs. machinery, $41,728. Norfolk—3 pkgs. material, $65. Newcastle—8 pkgs. machinery, $495; 12 pkgs. wire, $600; 1 pkg. material, $16. Naples—7 pkgs. material, $500; 134,989 lbs. copper, $18,898. New Zealand—10 pkgs. material, $391; 6 pkgs. wire, $224; 1 pkg. machinery, $10. Peru—22 pkgs. material, $726. Rotterdam—1 pkg. material, $50. Southampton—12 pkgs. material, $423; 153 pkgs. machinery, $39,709. Strassburg—5 pkgs. machinery, $462. United States of Columbia—10 pkgs. material, $302. Venezuela—12 pkgs. material, $332; 10 pkgs. copper wire, $216.

CONTRACTS FOR SHAW CRANES.—Manning, Maxwell & Moore, of 85-89 Liberty Street, New York City, report receipt of a number of substantial contracts for Shaw electric cranes. The Harrisburg Pipe & Tube Bending Company, of Harrisburg, Pa., has requisitioned for one 50-ton special steel casting crane, two standard cranes of 15-ton capacity each, also a 10-ton crane. These cranes are to be operated by 105-hp, 55-hp and 40-hp electric motors, respectively. The equipments are intended to be installed in the new steel casting and rolling mill plants of the Harrisburg Company. The new billet mill and steel casting plant about to be erected by the American Tube & Stamping Company, of Bridgeport, Conn., is also to be equipped with Shaw cranes. The contract calls for one special machine of 50-ton capacity and four standard cranes of 10-ton capacity each. The motors to drive the 50-ton crane will be of 105 hp, while the 10-ton machines are to be operated by 40-hp motors. The Vermont Marble Company, of Proctor, Vt., has ordered two 10-ton cranes for their new marble cutting works. The motors will be of 40 hp each. The value of these contracts aggregates over $60,000.

CROCKER-WHEELER GENERATORS.—Recent orders for the engine type generators of the above company have again given assurance of the high regard in which these machines are held by manufacturers all over the country. Among others the following companies have recently placed orders for these machines: Pittsburg Reduction Company, New Kensington, Pa., one 200 kw; National Mining Company, Sygan, Pa., two 200 kw; Lake Shore & Michigan Southern Railroad, Collingwood shops, Ohio, one 400 kw; Federal Lead Company, Alton, Ill., two 150 kw; Farrand Organ Company, Detroit, Mich., one 100 kw; Snellenberg & Co., Philadelphia, four 200 kw, one 100 kw; Harrisburg Pipe & Pipe Bending Company, Harrisburg, Pa., one 200 kw; American Bridge Company, New York, one 300 kw; Allis-Chalmers Company, Milwaukee, Wis., one 300 kw; Hawley & Hoops, New York, one 75 kw; Hall of Records, New York, two 150 kw, one 100 kw, one 50 kw.

ENGINES FOR N. Y. SUBWAY ROAD.—The Allis-Chalmers Company has contracted to furnish six additional engines of a maximum of 12,000 hp each, to be completed as soon as possible, for the New York Underground Electric road. These engines are to be duplicates of six engines now under contract, and will complete the power necessary to drive the machinery of the underground road, when completed. The full amount of the contract is $1,305,000, the price for each engine being $108,750, making the cost of the six engines now ordered amount to $652,500. The contract for the first six engines carried with it an option to increase the number to eight within two months from the signing of the contract at the same price, and to increase the order to the full complement of twelve. The six engines that are already contracted for are to be completed for delivery in 18 months from last October.

LINK-BELT ORDERS.—The Link-Belt Engineering Company, 49 Dey Street, New York City, have recently secured a contract from the Delaware, Lackawanna & Western Railroad for a locomotive coaling station to be installed at Hoboken, N. J. The capacity of the plant will be about 2000 tons. The equipment is to be operated by a 20-hp Crocker-Wheeler motor. The United Coke & Gas Company has requisitioned for a coaling bridge for handling coal from barges to storage, and from there to the retorts at its Camden, N. J., plant. The motors to drive same are to be two in number, of 30 hp each, Westinghouse induction type. The power is to be transmitted to the various shafts by means of the Renold silent chain, which is exclusively manufactured by the Link-Belt Company. The machinery will be built at the Nicetown plant of the Link-Belt Company.

BIDS FOR ST. LOUIS FAIR BUILDINGS.—Director of Works Taylor has advertised for bids on the Electricity and Machinery Building of the World's Fair. The architects estimate of the cost of construction is $400,000. Eight days will be allowed the contractors to figure on the work of erection. The conditions require a deposit of $10,000 and a penalty of $500 for each day of delay, together with a bond of one-third of the contract price.

THE VILTER MANUFACTURING COMPANY, builders of refrigerating and ice making machinery, Corliss engines, etc., of Milwaukee, Wis., has recently closed contracts with the following parties: Port Arthur Rice & Irrigation Company, Port Arthur, Texas, two 22 by 42 Corliss engines; Morris Paper Company, Morris, Ill., one 18 by 36 Corliss engine.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, of Pittsfield, Mass., has bought the plant of the O. S. Platt Manufacturing Company, of Bridgeport, Conn. The manufacture of the switches will be under the direction of C. C. Morgan.

ST. LOUIS WORLD'S FAIR.—The contract between the St. Louis World's Fair and the Westinghouse Electric & Manufacturing Company has been confirmed. Details of the big plant have already been given in these pages.

General News.

THE TELEPHONE.

SAN FRANCISCO, CALIF.—The Pacific States Telephone & Telegraph Company held its annual meeting recently in Portland, Ore., and a very favorable showing was made. The company authorized the expenditure of about $2,100,000 for improvements and extensions of the lines, etc.

SAN FRANCISCO, CALIF.—The Pacific States Telephone & Telegraph Company recently decided to enforce the order issued some time ago requiring all of its operators to submit to vaccination. Manager Glass has informed the Board of Health that arrangements have been made to have all of the telephone girls in San Francisco vaccinated at the rate of 100 a week.

SAN FRANCISCO, CALIF.—The Automatic Direct Line Telephone Company, which has been incorporated, with San Francisco as the place of business, purposes to construct and operate a telephone and telegraph line from its office in the city to Ocean View. The directors are: C. F. Runyon, Julius Fay, J. A. Stulz, A. K. Andriano and Robert Capelle. The capital stock is $250,000; subscribed, $1,500.

LEWISTOWN, IDAHO.—The Lewistown & Grassrange Telephone Company, of Lewistown, has been incorporated. The capital stock is $10,000. J. H. Charters, A. W. Ware and E. Brassey are incorporators.

BOISE, IDAHO.—The Rocky Mountain Bell Telephone Company is building an extra line between Boise and Nampa, and material is on the ground for a line between Blackfoot and Hailey, Idaho, thus completing the Salt Lake-Boise connection. An exchange with 53 new subscribers has been put in at Harrison in the Cœur d'Alene region, Idaho, and connections will be made with the rest of the interstate system.

OREGON, ILL.—The Ogle County Telephone Company has been granted a franchise in Forreston.

ABINGDON, ILL.—The Mutual Telephone Company, of Abingdon, has increased its capital from $2,500 to $10,000.

BENSON, ILL.—The Benson Telephone Company, capital $10,000, has been incorporated by S. L. Peterson, R. H. Parks and J. E. Eckhart.

PANA, ILL.—The Pana and Christian County Telephone Company has been incorporated with a capital of $15,000 by J. R. Chapman, Chas. R. Harris and Thomas Harrison, Jr.

NASHVILLE, IND.—The Nashville Telephone system has passed into the hands of the Morgantown Telephone Company.

SYRACUSE, IND.—The Syracuse Home Telephone Company, capital $25,000, has been incorporated by J. F. B. Kauffman, G. D. Lunt, of Goshen, Ind.; A. A. Rasor and Wm. Self and others, of Syracuse, Ind.

UTICA, IA.—The Union Telephone Company, capital $50,000, has been incorporated by F. J. Teal and others.

EAGLE GROVE, IA.—The Northwestern Telephone Company will build a line from La Porte to Eagle Center in the spring.

SHENANDOAH, IA.—The Oak Grove Telephone line has been organized. Allen Davison is president, and Wm. Grimes, secretary.

DOWS, IA.—Fifty farmers of Ingham Township, Franklin County, have organized a telephone company and incorporated under the laws of Iowa.

BOUTON, IA.—The Globe Telephone Company, of Bouton, capital $5,000, has been incorporated. J. C. Bryon is president; Chas. Hansen, vice-president; T. E. Scott, secretary, and J. J. Cannon, treasurer.

JEWELL, IA.—The Council passed an ordinance granting the Jewell Telephone Company a franchise to construct a telephone exchange, which will take effect after being submitted to and approved by the people at the coming election.

MACEDONIA, IA.—The Carson Telephone Company is making an effort to gain entrance to this city, but the City Council does not seem disposed to grant the desired franchise. The town already has two companies, the Nebraska and the Tabor.

KEOKUK, IA.—The Denmark Independent Telephone Company and the Wever Telephone Company have been incorporated. Franchises have been granted by the Board of Supervisors to both companies, one to build lines from Fort Madison to Denmark and the other from Fort Madison to Wever.

WATERVILLE, ME.—The application of the Dirigo Telephone Company for the right to erect poles and install its service for connection with its trunk lines to Portland and north and west via Farmington, was granted by the board of Aldermen.

DOWAGIAC, MICH.—The City Council has granted to M. E. Foote and W. T. Heddon, a twenty-year franchise to establish an independent telephone system in this city.

MINNEAPOLIS, MINN.—Suit has been brought by the Northwestern Telephone Company against the Twin City Telephone Company to compel the latter to remove all its ærial wires which are under the wires of the Northwestern Company at about 40 cents of crossing in this city.

NEVADA, MO.—A local stock company will build an independent telephone system from Montevello to Vergil Springs.

BOZEMAN, MONT.—The West Gallatin Telephone Company has been organized. E. Broox Martin was elected president.

BILLINGS, MONT.—A fight is on between the Rocky Mountain Bell and the Montana & Wyoming Telephone companies. The former, which controls the local system at Billings, recently cut off connections with the Wyoming-Montana Company, so that the patrons of the latter line can not talk with the Billings people. The Wyoming-Montana company has applied for a franchise in Billings.

STELLA, NEB.—The Stella Telephone Company, capital stock $10,000, has been incorporated by S. H. Thomas, H. E. Clark, J. F. Ackerman, B. L. Harris and Guy Harris.

RATON, NEW MEXICO.—The City Council of Raton, New Mexico, has been requested to grant Geo. J. Spear a telephone franchise.

BLOOMFIELD, OHIO.—A telephone line from Bloomfield to Smithfield will be constructed in the near future.

LISBON, OHIO.—The North Georgetown Telephone Company, of Columbiana County was incorporated, with a capital stock of $5,000.

MT. VERNON, OHIO.—The Mt. Vernon Telephone Company will build a line to Pipeville connecting up a number of people in that community.

CRIDERSVILLE, OHIO.—The Cridersville Telephone Company is preparing to extend its lines into the country connecting up many farmers in this vicinity.

WESTON, OHIO.—The Weston Mutual Telephone Company is about to establish a new central office. A 100-drop switchboard has been ordered and the lines are to be extended.

CIRCLEVILLE, OHIO.—The Circleville Citizens' Telephone Company is building lines to Laurelville, Adelphi, Stringtown, Tarlton and other towns in the county. Service will be given to farmers on the lines at $12 per year.

GENEVA, OHIO.—At a recent meeting of the Madison Telephone Company, E. U. Hyde was elected secretary of the company in place of E. Parker, who resigned. The company is preparing to make important improvements to the Geneva exchange.

MT. VERNON, OHIO.—Business men of this place have signed a protest and have agreed to not pay higher rates than at present to either of the companies doing business here. The Bell company is about to increase its rates from $15 to $36 per year.

CINCINNATI, OHIO.—It is officially announced that the Columbus, Ohio, Citizens' Telephone Company has passed out of the control of the Everett-Moore syndicate into the hands of Columbus capitalists. Capital, $300,000. The lines will be extended.

GREENVILLE, OHIO.—The Southern Ohio Independent Telephone Association, has been organized at Greenville, Ohio, by about fifty or sixty home and independent telephone companies. The purpose is to protect the independent companies and fight the Bell company.

CINCINNATI, OHIO.—Stockholders of the City & Suburban Telegraph Association have elected the following directors: Charles P. Taft, Charles Kilgour, John Kilgour, Henry Hanna, Wm. A. Blanchard, George Bullock and C. J. French, the last mentioned of Boston. The board will organize later.

SPRINGFIELD, OHIO.—H. P. Miller, district manager for the Central Union Telephone Company, has established his headquarters in Springfield. The local system is to be thoroughly overhauled and new long-distance instruments are to be installed throughout. After March 1 the residence rates are to be increased $1 per month.

MARIETTA, OHIO.—The Marietta Telephone Company has elected officers as follows: A. L. Gracey, president; A. C. Davis, secretary-treasurer; F. P. Moaps, general manager. The company is planning to enlarge the plant in order to take care of increased business. Free service has been inaugurated with Parkersburg, W. Va.

YOUNGSTOWN, OHIO.—Citizens of both Green and Poland townships are organizing to follow the example of citizens of Beaver township who have incorporated. The Beaver Telephone Company has secured over 200 subscribers to its service. It is the intention to have the three companies affiliated and interchange service, all using the same long-distance service.

CLEVELAND, OHIO.—It is authoritatively announced that negotiations for the purchase of the Detroit property of the Federal Telephone Company have reached a point where actual sale may be effected within a few days. It is claimed that the sale of this property could be made without in any way affecting the remaining telephone properties owned by the Everett-Moore syndicate and that its sale would simplify matters to a considerable degree.

CADIZ, OHIO.—The Harrison County Telephone Company has completed lines to connect with Sistersville and a number of oil towns in that section of West Virginia, as well as with Woodsfield, Somerton and other Monroe County towns. Lines to Freeport, Moorefield, Piedmont, Smyrna, Antrim, Londonderry, Cambridge, Zanesville, Coshocton, New Rumsley and Scio are either completed or under construction. Important extensions to the exchange will have to be made to take care of the large increase in subscribers.

CLEVELAND, OHIO.—It is the intention to increase the list of subscribers of the Cuyahoga Telephone Company from 9,000 to 12,000, and it is believed this can be accomplished in a short time by placing solicitors in the field. Because of the embarrassment of the Everett-Moore syndicate, nothing of the kind has been done for several months, and construction work has been at a standstill. The company already has switchboard and conduit facilities for 12,000 telephones. The Columbus exchange is badly in need of additional equipment. Work has been at a standstill for many months and over 1000 orders for new telephones are on the books. The same conditions exist in the majority of the exchanges controlled by the Federal company, and it is claimed that if required improvements are made at once, the earning capacity of the system will be doubled within a year. The uncompleted Detroit plant will undoubtedly be sold, but it is probable that the Dayton exchange will be completed and retained by the syndicate.

PLEASANTON, OHIO.—Mr. C. M. Pierce, of the Pierce Telephone Company, which was recently organized, gives some interesting details regarding the plans of the associated interests. Six months ago there was not a telephone in the vicinity, but to-day nearly 1000 farmers in this and adjacent counties are in telephonic communication with co-operative exchanges. The method employed by this concern, which is one of the several of similar nature, is to select a central point, purchase a switchboard, employ a switchboard tender, etc., and get the farmers in the surrounding neighborhood to build lines to the switchboard. No line is permitted to have fewer than nine telephones, nor more than fifteen, the person owning the switchboard making a contract, usually for ten years, with the owners of each line connecting therewith to give switchboard service for $2.15 a month. The exchanges are connected with one another, free service being given between them. On the payment of a very reasonable toll, con-

nection can be had with Columbus, Cleveland and other large cities by long-distance lines. The cost of each share in the company is from $20 to $30, including the building of the line, cost of telephone ($2), switchboard fees, etc.

GRAND RAPIDS, OHIO.—This town is the center of a mutual telephone system which is something unique. The village and vicinity for a distance of twenty-five miles in every direction, including the towns of Weston, Tontogany, West Hope, McClure, Grelton, Malinta and Holgate are connected by a system of telephones that is well-nigh complete. A majority of the farmers in this section are members of the association. The membership numbers nearly 500, and is increasing rapidly. Each line is composed of from eight to ten members. All lines going to a village purchase and support a small central board. Each town is connected by a wire from one central to another. A subscriber has free use of any line composing the entire system by paying his pro rata in the support of the individual line and the central. The transfer from one line to another or through neighboring towns to its residents is done by mutual courtesy. Every line of eight to ten members has its by-laws, president, vice-president, secretary-treasurer, four directors and a trustee. From $15 to $20 includes actual cost to each subscriber for his telephone, which is the best long-distance instrument made. This sum further includes his interest or share of expense for a central, the wires, cross arms, etc., which make up the line. By an actual experience the cost of supporting a central for day and night operating averages from 15 to 30 cents per month. At Tontogany the United States Telephone Company is preparing to connect with the exchange, thus giving the system long-distance connections. At Grand Rapids, the new Home Telephone Company has established a toll station, thus giving the community outward communication over foreign lines. The Toledo Home Telephone Company which is building a new exchange in Toledo, is also preparing to make connections with the mutual system.

OTTAWA, ONT.—A combined move is to be made, on behalf of the various municipalities of the province of Ontario, to limit the powers of the Bell Telephone Company, of Canada, in regard to rates and other matters. A circular has been issued setting out fully the position of the telephone company, and urging that legislation be sought at the present session of the Dominion Parliament to compel the company to supply telephone service to all who apply for same, and whose premises are on a line of supply of the company, in the same way as municipal councils who supply water, gas or electric light are required to furnish it. The municipalities are informed that the company will apply, at this session of Parliament, for power to increase capital stock, and that this fact affords an opportunity to have passed the new legislation sought for by the municipalities.

PLATTE, S. D.—The Platte Telephone Company, capital $2,000, has been incorporated by T. E. Andrews, B. H. Brady, Geo. R. Ellsworth, J. W. Gray and F. C. Smith.

SHERIDAN, WYO.—The Powder River Telephone Company filed articles of incorporation, with a capital stock of $10,000. This company will operate in Johnson County principally.

CODY, WYO.—Two telephone companies are building to Cody, and both are attempting to secure an exclusive franchise from the town. They are the Red Lodge Telephone Company and the Big Horn County Telephone Company. The latter asks for a twenty-year exclusive franchise, and the former asks for a fifteen-year exclusive franchise.

ELECTRIC LIGHT AND POWER.

SACRAMENTO, CALIF.—The city of Sacramento, Calif., is considering plans for the installation of a municipal lighting system.

PETALUMA, CALIF.—The Petaluma Power & Water Company's plant in Petaluma, may be purchased by the municipality. The company's price is $218,000. The City Trustees expect to call a bond election.

SAN FRANCISCO, CALIF.—The Barbee Mining Mill, Silver Reef, Utah, controlled by the company of which Mr. T. L. Brundage is president, will be enlarged and improved this season. An electric power plant will be installed.

SAN FRANCISCO, CALIF.—The Pomona & Ontario Light & Fuel Company, which was recently incorporated in California, will operate in the above-named towns for the purposes of manufacturing and distributing gas and electricity for light and heat.

SAN FRANCISCO, CALIF.—An electric light and power plant will be installed by A. D. Frame, who has accepted the franchise granted him by the authorities of Baker City, Oregon. The water power electric station will be located on Eagle Creek.

SAN FRANCISCO, CALIF.—It is reported that the Fresno Gas & Electric Company has been purchased by John Martin and other capitalists interested in the California Central & Electric Company. It is their policy to buy up electric and gas plants and operate them in connection with the large companies which they control.

SAN FRANCISCO, CALIF.—The Consolidated Light & Power Company, which is allied to the Standard Electric Company, of California, will hold a meeting in San Francisco on March 17, for the purpose of authorizing an issue of bonds to the amount of $200,000. The funds thus raised will be used to extend and improve the distributing system for the Standard Electric Company's current in Santa Clara County and other points south of San Francisco.

MONTREAL, CAN.—The report submitted at the annual meeting of the Lachine Rapids Hydraulic & Land Company, held at Montreal recently showed that during the year ended Dec. 31 last, the company earned $190,000, from which the sum of $37,000 being deducted for bond interest, bad debts, etc. left a net profit of $153,000. The semi-annual dividends paid were 3 and 3½ per cent, made in June and December respectively, and amounted to $112,046. The increase in the company's business during the year was as follows: Incandescent lamps, 16,318; alternating arcs, 116; horse-power of motors connected, 563. Guided by past experience, the directors have decided that it is necessary to acquire further property upon which to erect a fireproof transforming station, switchboard room, etc., and for this purpose land has been purchased already.

GEORGETOWN, COLO.—Application has been made to the Georgetown Council for a franchise by the Seaton Mountain Electric Company, of Idaho Springs, Colo. This is a retaliatory measure because of the Georgetown plant selling electricity to the Cascade company, of Idaho Springs, which reduced the prices for lights 25 per cent under the older company, and in addition gave a discount of 60 per cent. The people of Idaho Springs have been enjoying free lights since Oct. 1, with no sign of a settlement. The two companies have fought hard for the business in the Springs, with a stand-off between them.

INDIANAPOLIS, IND.—E. E. Rine, an Indianapolis electrician, has invented an incandescent lamp by which the degree of illumination may be varied.

LAWRENCEBURG, IND.—The City Council has leased the new electric light plant erected by Messrs. Fox and McKim. The lease contains a clause providing for purchase and the applying of certain payments on the purchase price.

DULUTH, MINN.—The electric lighting and power plant of the Commercial Light & Power Company of this city has been sold under foreclosure proceedings to the Duluth General Electric Company. The price was $107,408.92. The Duluth General Electric is a reorganized company, formed by the bondholders of the old company.

WHITE SULPHUR SPRINGS, MONT.—A municipal electric lighting plant, to be installed in connection with the water works system, is proposed in White Sulphur Springs, Mont. Mayor Temwell will investigate the details of an electric plant and report to the City Council.

ALBUQUERQUE, N. MEX.—The new addition to the electric lighting plant of Albuquerque will enable the company to light the surrounding mines and camps, as well as improve the city service.

ALBANY, N. Y.—The Oneonta Light & Power Company, of Oneonta, Otsego County, has been incorporated with a capital of $175,000.

HALIFAX, N. S.—The People's Heat & Light Company, of Halifax, which is talked of as likely to be taken over and operated by the Halifax Electric Tramway Company, which also does an electric lighting business, is capitalized at $700,000 and has a bond issue to that amount. This company did not meet the interest on its bonds when the last payment fell due, on Oct. 1, 1901, and the holders agreed to wait for a year before taking any action.

MIAMISBURG, OHIO.—N. J. Cartow, W. A. Mays, C. Weber and others have asked for a franchise for a lighting, power and water works plant.

CHILLICOTHE, OHIO.—Unless the Chillicothe Gas, Light & Water Company accepts the Council's terms for lighting service, the people will vote next month on the question of a municipal plant.

CANTON, OHIO.—The Central Heat & Power Company has accepted the franchise recently granted and will built its plant at once. P. J. Bernower, V. L. Ney, and L. C. Wise are proprietors.

ZANESVILLE, OHIO.—The City Council has granted a franchise to the Citizens' Electric Light Company, conditional upon supplying a number of free lights to the city and the construction of the plant within eighteen months.

OTTAWA, ONT.—At the annual meeting of the shareholders of the Cataract Power Company, of Hamilton, Ont., it was decided to increase the capital stock of the company by an addition of $50,000, for the purpose of extending the Radial Railway from Burlington to Oakville. Operations on the extension will likely be commenced as soon as the stock is subscribed.

OTTAWA, ONT.—There is likely to be keen competition between two rival groups for a charter giving authority to generate electricity, or hydraulic power, for lighting, heating and other purposes, and to construct and operate an electric railway from Niagara Falls to Toronto. Notice of application to the Dominion Parliament has been given by one of the syndicates under the title of the Canadian Power Company and the rival corporation is to be called the Dominion Power Company.

EUGENE, ORE.—An electric lighting plant to supply Eugene is projected by J. L. Chambers, who has asked the City Council for a lighting franchise.

NEPHI, UTAH.—The towns of Fountain Green and Nephi, Utah, situated eighteen miles apart, are likely to co-operate in the construction of an electric lighting system that will supply both towns.

MILWAUKEE, WIS.—At a meeting of the board of directors of the Milwaukee Electric Railway & Light Company, held Feb. 20, for organization, the following officers were elected for the ensuing year: John I. Beggs, president and general manager; Wm. Nelson Cromwell, first vice-president; Charles W. Wetmore, second vice-president; George R. Sheldon, treasurer; Charles A. Spofford, secretary; George O. Wheatcroft, assistant secretary and assistant treasurer at Milwaukee. The same gentlemen were elected to the corresponding officers for the Milwaukee Light, Heat & Traction Company.

MILWAUKEE, WIS.—Local fire underwriters have petitioned the city to establish a city electrical inspection department. It is claimed that a great many fires have been caused by defective electric light wires. The local Board of Fire Underwriters has an electrical inspector.

THE ELECTRIC RAILWAY.

LOS ANGELES, CALIF.—The Pasadena & Los Angeles Electric Railway Company has ordered 150 new cars, to be used on the run between Los Angeles and Pasadena.

SANTA PAULA, CALIF.—John Burson has been granted an electric railway franchise from McIntyre's Ranch to Santa Paula. The Ventura County Supervisors have also granted a franchise to J. S. Collins from Santa Paula to Ventura.

SAN FRANCISCO, CALIF.—Bids will be received in Bakersfield, Calif., up to 3 P. M. on April 7 for the street railway franchise applied for by Messrs.

Verider and La Coste. They asked for a 50-year franchise and to use electricity or any other power except steam.

SAN FRANCISCO, CALIF.—It is reported that the purchasers of the Market Street Railway Company, San Francisco, will expend $2,500,000 in extending the San Francisco & San Mateo Electric Railway line from San Mateo to San Jose. The line is not yet completed to San Mateo, but it probably will be during the present year.

DANBURY, CONN.—The Westchester Traction Company of New York has acquired the Danbury & Harlem Railway, a partly completed road running from Danbury to Goldens Bridge, N. Y., where it connects with the New York & Harlem road. The Westchester company is to complete the road and extend it to White Plains and to the Hudson River.

INDIANAPOLIS, IND.—Minority stockholders in the Indianapolis & Greenfield Rapid Transit Company have sued for a receivership and accounting. The complaint alleges gross fraud, and that the defendants, now in control, ignored their rights; that they awarded contracts of construction to the Kirkpatrick Construction Company at enormous prices and then accepted the work when not completed according to specifications; that they have failed to make any report of the earnings, and that they have illegally and without right retained for themselves $150,000 in second mortgage bonds and $120,000 in stock, which together with the $100,000 in stock originally owned they then controlled the affairs of the company. It is also alleged that this stock was obtained through fraudulent representations. The plaintiffs ask for a receiver, an accounting and $40,000 damages, and that the court declare null and void the $150,000 second mortgage bonds and the $120,000 stock now in defendant's hands. The suit was a great surprise to the community and a big legal battle is imminent.

DETROIT, MICH.—At a meeting of the directors of the Detroit United Railway, held Feb. 22, the usual quarterly dividend of 1 per cent. was declared. It is understood that the stockholders of the company are not responding very favorably to the proposal of the Cleveland bankers' committee of depositing their stock for sale at $70. The general impression is that the stock should bring a considerably higher figure.

STEUBENVILLE, OHIO.—It is stated that the Steubenville & Mingo Traction Company proposes to construct a new line between Steubenville and Mingo over the county pike.

CIRCLEVILLE, OHIO.—The Circleville Council has advertised for bids for electric railways over four routes in the town. The franchises are wanted by the Scioto Valley Traction Company.

ASHLAND, OHIO.—T. Y. McCrea, of the Mansfield, Savannah & Wellington Railway, has asked the Ashland Council for a franchise for a spur line which the company proposes to build into the town.

YOUNGSTOWN, OHIO.—A. A. Anderson, of the Mahoning Valley Railway Company, has purchased a site near Lansingville which is taken to indicate that the company will erect its much talked about power station at that point.

CONNEAUT, OHIO.—The Pennsylvania & Ohio Railway has increased its capital stock from $600,000 to $700,000. The charter was amended to permit the building of a line to Jefferson, work on which will start as soon as possible.

MANSFIELD, OHIO.—The Mansfield, Savannah & Wellington Railway has been granted an extension of franchise to Nov. 1, 1902, in which to commence work within the town. The company has about sixteen miles of road graded and the work will be pushed as soon as weather permits.

CANTON, OHIO.—The Stark Electric Railway Company has been granted an extension to Jan. 1, 1903, in which to build its line in Canton. The company has already spent $250,000 in construction work. Rails are being laid between Alliance and Sebring, and the power-house near Alliance is nearing completion.

MT. VERNON, OHIO.—Stockholders of the Mt. Vernon Electric Light Company and the Mt. Vernon Electric Railway Company met a few days ago. The resignation of D. K. Bird as secretary and manager of both companies was accepted and C. E. Johnson, of Middletown, Conn., was elected to succeed him. J. W. O'Neil, of Topeka, Kan., was elected president of both companies, and E. Q. Jackson, of Middletown, Conn., treasurer. It is the intention to consolidate both companies under one organization, to be known as the Ohio Light & Railway Company. A large power-house will probably be erected.

OTTAWA, ONT.—The largest electric railway project yet launched in Canada was sanctioned by the Railway Committee of the Ontario Legislature, when the Cornwall and Toronto bill, providing for the building of a line along the lake front from Cornwall to Toronto, came up for consideration. The company includes A. J. Jewell and G. E. Smith, of Boston, and H. N. Smith, of Salem, Mass.; Sir R. J. Cartwright, Minister of Trade for Canada, and others. It proposes to build a trunk line 350 miles long, including one from Brockville to Ottawa and branches at various points, as far as thirty miles back from the main line. The Railway Committee was assured that it was a solid concern, with plans for the spending of $8,000,000.

PITTSBURG, PA.—A big surprise is the announcement that the Philadelphia company which controls the city's heat, light and traction service, had bought the elevated railroad franchises secured by Thomas Bigelow, the Olivers and Richard Quay at the last session of the Legislature. The news came out in a letter to Recorder Joseph Brown from President Reed and Vice-President Callery, of the Philadelphia company, who asked that a commission be appointed to consider the question of constructing one or more roads to relieve the congested traffic in the city. The letter says that something must be done at once, and with this object in view the company bought the elevated railroad franchises.

SEATTLE, WASH.—The Seattle Electric Company has purchased the line of the Seattle Central Street Railway Company.

JANESVILLE, WIS.—The Janesville Street Railway Company has prepared plans for new car barns to replace the barns recently destroyed by fire.

LA CROSSE, WIS.—An electric road from La Crosse to Viroqua may be built during the coming summer. C. J. Smith, of Viroqua, is one of the principal promoters.

CHIPPEWA FALLS, WIS.—The Chippewa Valley Electric Railway Company is considering various improvements, including a large storage battery plant at the power station near Magenta. The company contemplates extending its line in several directions.

CHILTON, WIS.—It is reported that Fond du Lac and Chicago capitalists are about to build an electric railway from Chilton to Fond du Lac, taking in the small towns along the shore of Lake Winnebago. The promoters have an option on the electric light plant in this city.

KENOSHA, WIS.—It is reported that a new street railway franchise ordinance will be sent to the City Council. The ordinance will be presented by the Kenosha Street Railway Company, now holding a grant in the city, but it will probably be presented under the name of the Chicago & Milwaukee Electric Railway Company.

THE AUTOMOBILE.

CHICAGO AUTOMOBILE SHOW.—The automobile show at Chicago opened at the Coliseum Saturday afternoon, March 1, to continue one week. Although at the opening time many exhibits were not in place there was sufficient to show that the electric vehicle would be well represented, and that the electrical part of the gasoline engine is receiving considerable attention. Speed tests this year are on a testing platform, as no good track is available.

NATIONAL AUTOMOBILE CLUB.—A telegram from Chicago of March 4 says: "Delegates from eight of the leading motor vehicle organizations of the East and the West at the Coliseum to-day, completed the formation of a national body to be called the American Automobile Association. The organization will be governed by a board of directors, composed of the president, first vice-president, and treasurer, ex-officio, with the seven other directors. Each club will have as many votes in the association as it has active, associate and life members, and will pay $10 initiation fee and $3 annually as dues for each of its members. There will be annual meetings of the association in the spring, alternating between the East and West. Officers were chosen from the eight altersending delegates to the convention as follows: Winthrop E. Scarritt, Automobile Club of America, President; F. C. Donald, Chicago Automobile Club, First Vice-President; W. W. Grant, Long Island Automobile Club, Second Vice-President; W. G. Morris, Automobile Club of Philadelphia, Third Vice-President; Jefferson Seligman, Automobile Club of America, Treasurer; S. M. Butter, Secretary of Automobile Club of America, Secretary; F. G. Wells and A. E. Pardington, Long Island Automobile Club; A. R. Shattuck, Automobile Club of America; W. J. Stewart, New Jersey Automobile Club; F. C. Lewin, Automobile Club of Philadelphia, and Dr. Chase, Automobile Club of Rhode Island.

NEW INDUSTRIAL COMPANIES.

THE INTERNATIONAL WIRELESS TELEPHONE COMPANY is to be formed in Muncie, Ind., to exploit the system invented by A. L. Bolen, of that city.

THE DEFOREST WIRELESS TELEGRAPH COMPANY, of Kittery, Me., capital $3,000,000, has been incorporated by E. L. Chaney, Kittery, Me., and M. W. Baldwin, Boston, Mass.

THE AUTOMOBILE STORAGE & TRADING COMPANY, of Albany, capital $25,000, has been incorporated. Directors: F. G. Robinson, R. M. Robinson and K. F. Robinson, of Albany.

THE AMSTUTZ-OSBORN COMPANY, of Jersey City has been incorporated to manufacture electrical supplies; capital, $100,000. Incorporators: H. C. Osborn, H. B. Stough and P. J. Morgan.

THE ALPHADUCT MANUFACTURING COMPANY, of New York (electrical supplies), capital $50,000, has been incorporated. Directors: Courtney Hyde, Russell Dart, Jr., E. D. Speer, New York.

THE LOZIER MOTOR COMPANY, of New York, has been incorporated, with a capital stock of $500,000. The principal office is in Plattsburg. The directors are: Frank E. Smith, of New York City, and George S. Weed, Thomas B. Cotter, Walter W. Gregg and Charles A. Emise, of Plattsburg.

LEGAL.

SUBMARINE BOAT FIGHT.—The Holland Submarine Torpedo Boat Company has instituted another action against the Lake Torpedo Company at Bridgeport, Conn., and the plant of the latter company was attached to satisfy the claim of damages of $50,000. The case is returnable April 1. Operations were suspended at the Lake plant in consequence of the damage suit. The action is based upon the allegation that the Lake company has libelled the Holland company by the alleged malicious publication of a circular setting forth the merits of the Lake type of submarine craft in a manner which is averred to be damaging to the business of the Holland company. Included in the property attached is the only Lake submarine torpedo boat in existence, which the company was constructing for demonstration purposes before the Navy Department at Washington next month. The boat is practically completed and would have been launched within a few days. The Lake company says that the action was brought by the Holland company to prevent the demonstration of the Lake boat at Washington. In its bill of complaint the Holland company asserts that it has contracts with the United States Government for the construction of five submarine torpedo boats, seven for the British Government, and that it is negotiating with Powers in Europe, Asia and South America for other contracts, and that the publication by the Lake company of a "confidential circular" has materially injured its reputation and credit.

PERSONAL.

LORD KELVIN has cabled to Mr. Marconi his "hearty congratulations" upon his latest success in receiving messages at 1500 miles at sea, and signals at 2099 miles.

MR. JACOB CLOOS, consulting engineer, has opened up offices at 1001 Pabst Building, Milwaukee, Wis. Mr. Cloos is very active in engineering several large electric power and light installations.

MR. LUTHER STIERINGER, after a prolonged convalescence following his work at the Pan-American, has gone south to Florida and will study the Charleston Exposition en route. He will be gone a couple of months.

MR. THOS. A. EDISON, after postponing his departure South until after the reception of Prince Henry in New York, has left for Florida, where he will spend some weeks resting and enjoying a good time on his plantation.

PROF. F. R. HUTTON, dean of the faculty of applied science of Columbia University, is to lecture before the Automobile Club of America on March 11, his subject being "The Fundamental Principles Underlying the Design of Automobiles."

MR. A. S. CLIFT, electrical engineer with Siemens Bros., Limited, in England, and formerly with the Crocker-Wheeler Company in this country has an interesting article in *Cassier's Magazine* for March on the telpherage system and its importance.

MR. R. G. WILLIAMS.—A cable dispatch from London of March 1 says: Rupert Greville Williams, the inventor of the telepantograph, by which sketches can be sent by telegraph, committed suicide at Heywood, in Lancashire, on that day. He was 46 years of age.

MR. P. W. DAVIES, operating secretary of the British Traction Company, is in this country and has been making his headquarters at the office of the *Street Railway Journal*. He intends to take back some electric railway engineers with him to operate roads owned by the corporation.

MR. THOS. D. WATSON, for the past seven years associated with Messrs. J. Jones & Son, New York, has recently severed his connection with this firm and accepted a position with Mr. William Roche, the manufacturer of New Standard dry batteries and specialties. Mr. Watson has charge of the sales department.

M. MAURICE LEBLANC, of Hutin & Leblanc, of patent fame, is at present in this country and was at the meeting of the Institute on Friday, Feb. 28, when President Steinmetz welcomed him in the name of that body, on motion of Mr. J. W. Lieb, Jr., and expressed the pleasure of the members at his presence among them.

MR. S. L. G. KNOX, engineer in charge of the drafting department of the General Electric Company at Schenectady, and chairman of the Committee on Mechanical Design, has accepted the position of chief engineer and manager of the Bucyrus Company of South Milwaukee, Wis. Mr. Knox is an associate member of the A. I. E. E.

JUDGE J. M. THOMAS.—Reports have been in circulation that Judge Thomas had ceased his connection with independent telephony. This appears, however, to be quite without foundation. A friend of his who is in a position to speak authoritatively states that Judge Thomas has not left the independent ranks and has no intention of doing so. He has retired from the presidency of the New York company, but that has little significance, as he has simply yielded the position to one who is an expert in telephone construction work; but continues as a director. As a matter of fact, he is now at work on more comprehensive plans for the development of independent telephone lines throughout the country than ever before attempted and working harder than ever to build up the movement.

OBITUARY.

MR. LEONARD LEWISOHN.—The sudden death is announced from London, England, of Mr. Leonard Lewisohn, of Lewisohn Bros., one of the leaders in the copper industry. Their business had of late, as copper selling agents, all been transferred to the United Metal Selling Company. He was a native of Hamburg, Germany, and fifty-four years old, and came to this country when sixteen as an agent for his father in the feather business. He had accumulated a large fortune, and was liberal in his charities, etc.

MR. JEROME WHEELOCK.—At Worcester, Mass., on Feb. 26, Jerome Wheelock, inventor of the Wheelock engine, fell dead on the street of heart disease. He was nearly sixty-eight years of age. He was born in Grafton June 20, 1834. He was a practical mechanic from boyhood, gradually working himself up to an engineer's position. He then invented a cylinder packing, and while engaged in its manufacture, invented the valves that were the chief feature of his engine. He manufactured his machine many years and sold a great many. His inventions were patented all over the world. He retired from active business several years ago. He is survived by two sons.

Trade Notes.

THE BANNER ELECTRIC COMPANY, Youngstown, Ohio, reports that it is exceedingly busy.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY'S Cleveland office has been made a district office with considerably larger territory than heretofore. C. S. Powell is manager.

THE CINCINNATI PLANER COMPANY, of Cincinnati, Ohio, again finds it necessary to increase its facilities and is now letting the contract for a new addition, a one-story brick structure with basement, to be used exclusively for erecting purposes.

MESSRS. CHARLES E. STAMP & COMPANY, New England Building, Cleveland, Ohio, have been appointed sales agents for the Milwaukee Electric Company for the district of Northeastern Ohio. E. H. Monasmith is in charge of the electrical department.

BULLOCK ILLUSTRATED CALENDAR.—The March calendar of the Bullock Electric Manufacturing Company, Cincinnati, Ohio, contains a medallion picture of Sir Charles Wheatstone. On the back of the card is given a brief outline of Sir Charles' lifework.

THE STANDARD UNDERGROUND CABLE COMPANY has removed its Boston offices to the Converse Building, 101 Milk Street, where it now has more commodious and more centrally located quarters. Mr. W. B. Sausman is manager of the New England sales department.

THE AMERICAN VULCANIZED FIBRE COMPANY, 1017 Market Street, Wilmington, Del., announces that it has taken charge of the sales and purchasing departments of the American Hard Fibre Company, of Newark, Del., and the Kartavert Manufacturing Company, of Wilmington.

THE SHELBY ELECTRIC COMPANY.—Mr. Fish, secretary of the Shelby Electric Company, Shelby, Ohio, reports that his company's business during the month of January last was one of the best for any one month in the company's history. The plant is running night and day, so great is the demand for its special coil filament lamps.

DRY BATTERIES AND NOVELTIES.—Mr. G. C. Thornton announces that his business of manufacturing electric dry batteries and novelties has been transferred to the Thornton Electric Works, Incorporated, 3 East Fourteenth Street, New York. The officers of the company are W. F. Thornton, president; Charles E. Brower, vice-president, and G. C. Thornton, secretary and treasurer.

"NOARK" FUSES.—The H. W. Johns-Manville Company has just issued some printed matter descriptive of its "Noark" enclosed indicating fuse devices. The company proposes to produce a complete line of bulletins relative to enclosed fuse devices. Bulletins 6, 7, 9 and 10 are devoted to fuse and fuse blocks for different voltages, and contain much other information on the general subject.

COLUMBIA TELEPHONE SUPPLY COMPANY.—The amount of stock required to induce the Columbia Telephone Supply Company to locate in Ottawa, Ohio, has been subscribed, and it is believed the deal will be closed at once. Plans have been prepared for a two-story brick factory building 200x75 feet, and it is proposed to employ 100 men at the start. James G. Nolan and Fred. J. Mason, Chicago, are at the head of the company.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is prepared to send upon application a circular fully describing the loud ringing extension bell which it is selling. This bell is especially desirable for telephone service where the instruments are placed in factories and other noisy places. They are mounted on hard wood bases with nickel plated trimmings which make them adaptable for use in offices where a bell of neat appearance is desired.

FREE POSTAL CARDS.—The Cutter Company, of Philadelphia, has hit upon a scheme to attract attention to its products, which bids fair to become popular. It is distributing half a million postal cards among its customers. Each postal card bears a small illustration of some of the apparatus manufactured by it, either flush switches, instruments or circuit breakers, in the corner, together with some catchy phrase in very small type, thus leaving plenty of space on the card for other use. A card which has reached us refers to the excellence of the Keystone instruments.

THE CARPENTER ENCLOSED RESISTANCE COMPANY, New York, reports that its business has grown so rapidly during the past few weeks that it has been obliged to install new machinery, etc., and acquire additional manufacturing space. Orders received during the month of February were double those of January, and four times the business of December. The company states that its enclosed type resistances, reversing printing press and crane controllers, resistance units and field controllers for large dynamos, are giving the best of satisfaction. Increased orders are coming in from old as well as new customers.

EMERSON MOTORS.—The Emerson Electric Manufacturing Company is sending circulars out to the trade making a very favorable proposition, with a view to extending the use of its motors. It offers to send to any electrical dealer or central station of financial responsibility in the United States, one sample each of such types of its 1902 desk and ceiling fan motors as may be designated, these samples to be returned after 30 days' trial, at the company's expense, if for any reason it should be desirable to do so. The Emerson company keeps a large stock of its entire line at St. Louis, and also at its Eastern branch office in New York City.

HAZARD INSULATED WIRES.—The Hazard Manufacturing Company, of Wilkesbarre, Pa., supplied some of its rubber covered wire for the telephone system on the Pan-American grounds. The following report on its work will be noted with interest: "The independent telephone system which was operated on the Exposition grounds was installed by the Stromberg-Carlson Company. This system, together with the fire alarm system, worked perfectly and the telephone system in particular deserves particular mention. The network of wires run for telephone service paralleled in the same water-soaked wooden ducts, heavy current conductors carrying alternating current, potentialed anywhere between 104 and 1800. The service given was excellent and such could not have been true if these wires and insulation had not been of good material and workmanship."

GENERAL ELECTRIC BULLETINS.—Direct-current motors forms the subject of Bulletins No. 4275-6 of the General Electric Company. One of the bulletins is on the CE motor built for slow speeds in sizes ranging from 2 to 15 horse-power, and in moderate speeds from 3 to 20 horse-power. The second bulletin is on small direct-current motors of the type CA, ranging in sizes from ⅙ to 2-horse-power, and wound for 115, 230 and 500 volts. Both bulletins are profusely illustrated and show applications of the two types of motor to a number of machine tools. Bulletin No. 4277 relates to type C, form D, circuit-breaker. This was formerly known as type CB circuit-breaker, and made only for use on direct currents. The new type is now manufactured for alternating current work also. Bulletin 4278 is on horizontal edgewise ammeters designed primarily for alternating currents. Other recent publications of the General Electric Company are a circular on the radial fan motor described and illus-

trated in these columns Feb. 22 last. In this type the fan is placed in a horizontal position and so revolved as to draw air from above and force it against a reflecting surface directly beneath the fan, thus causing a gentle breeze to proceed horizontally in all directions. Another circular is on snap switches, and a third on an apparatus for blue printing with enclosed arc lamps.

THE ELECTRIC FOUNTAIN COMPANY OF AMERICA.—The Darlington Electric Fountain & Supply Company, of Philadelphia, has been reorganized and incorporated under the laws of Delaware as the Electric Fountain Company of America, the new company taking over the entire business which has been built up by Frederick W. Darlington, the president, whose familiarity with the fountain business is well known. It has been largely due to his skill and energy that the electric fountain has the position as an attraction that it now holds. Besides the design and construction of illuminated and other types of fountains, the large factory which the company intends to build will have a sufficient capacity for the supplying of all kinds of specialties in hydraulic apparatus, such as fire nozzles, automatic valves, etc. It is understood that the company not only has options on several patents in the fountain line, but that Mr. Darlington is now at work upon several ingenious improvements. Among these may be mentioned an attachment whereby musical effects can be produced in combination with those of light and water. The company is already on a good financial footing and it intends to erect in the near future the manufacturing plant which will be necessary for carrying on its business. Among those of other consulting engineers, the services of Mr. Luther Stieringer have been secured, and his reputation as an expert designer of artistic effects guarantees all work with which he is in any way connected. The offices of the Electric Fountain Company of America are in Philadelphia.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED FEBRUARY 25, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

693,841. CURRENT REGULATOR FOR ELECTRIC TRANSFORMERS; F. R. M. Cutcheon, St. Paul, Minn. App. filed Oct. 12, 1901. A primary coil is wound on the yoke of a U-shaped core and the secondary coil on the prongs of said core. An adjustable armature or bar working in the field of the secondary coil serves to magnetically short circuit said field and, by adjustment, vary the strength of the coil. The secondary coil is wound in sections spaced apart and connected in series. If, for example, a transformer is for five lamps and only three lamps are in circuit, the limits of motion of the armature is so adjusted as to only influence the secondary circuits of the three lamps.

693,855. APPARATUS FOR PREVENTING COLLISIONS AT SEA; Nicolas Gherassimoff, St. Petersburg, Russia. App. filed June 20, 1899. (See Current News and Notes.)

693,863. AUTOMATIC REGULATOR FOR STORAGE BATTERY SYSTEMS OF DISTRIBUTION; C. H. Holderreith, Brooklyn, N. Y. App. filed June 21, 1901. The end cells are switched in and out of circuit automatically by means of a motor operating the switches; two circuit controlling magnets direct the current through the motor in opposite directions, and are normally prevented from operation by being energized.

693,864. ATTACHMENT PLUG; C. F. Howes, Cambridge, Mass. App. filed April 28, 1900. Details of construction whereby a simple form of plug is obtained.

693,889. TELEPHONE EXCHANGE SWITCHBOARD SYSTEM; W. S. Paca, Erie, Pa. App. filed March 15, 1901. (See page 443.)

693,890. TELEPHONE EXCHANGE SYSTEM; W. S. Paca, Erie, Pa. App. filed March 15, 1901. (See page 443.)

693,916. CONDUIT FOR ELECTRIC WIRES; E. D. & H. N. Speer, New York, N. Y. App. filed Oct. 25, 1901. The conduit is made up of an inner flexible tube wound with a layer of fireproof cord; and this layer surrounded by another layer of fireproof material.

693,918. PROCESS OF FORMING BODIES BY ELECTRODEPOSITION; Carl Steinweg, Ludenscheid, Germany. App. filed July 1, 1901.

693,935. SAFETY ATTACHMENT FOR CARS; C. A. Willard, St. Louis, Mo. App. filed June 22, 1901. A guard is thrust rearward from the end of the car to prevent persons from walking around the rear end of the car and into danger of being run down on the adjoining track.

693,944. STREET RAILWAY SWITCH; W. J. Bell, Los Angeles, Calif. App. filed Dec. 14, 1901. The system of levers is normally under spring tension and the car automatically closes a circuit through a magnet which release the system and allows it to throw the switch, the switch being afterwards re-set, mechanically, by the car.

693,988. TROLLEY FOR ELECTRIC CARS; E. W. Taylor, Spokane, Wash. App. filed Dec. 26, 1900. The trolley has both lower and upper contact, between which the wire is embraced and upon which wire the trolley can swing laterally, as a pivot in passing forks, or branches of the wire, at switches.

693,995. ELECTRIC SWITCH; T. H. Brady, New Britain, Conn. App. filed Dec. 7, 1900. The invention consists of male and female bent sheet metal clips.

694,018. ELECTRIC HEATING DEVICE; E. Kastner, Berlin, Germany. App. filed June 17, 1901. An electric heater is enclosed in a tube which is adapted to be thrust into a liquid for heating the same.

694,020. TROLLEY POLE SUPPORT; F. H. Lippincott, Philadelphia, Pa. App. filed July 16, 1900. A retracting mechanism for lowering the pole is tripped into operation when the pole rises above the wire.

694,041. SANITARY SHIELD FOR TELEPHONE TRANSFORMERS; J. B. Tauveron, New York, N. Y. App. filed May 18, 1901. (See page 443.)

694,075. ELECTRIC MOTOR; F. A. Pocock and C. W. Kennedy, Philadelphia, Pa. App. filed July 29, 1897. An automobile motor in which the field magnet is connected to one wheel and the armature to the other, with interposed gearing for giving both wheels a rotation in the same direction.

694,089. ZINC ELEMENT FOR PRIMARY BATTERIES; H. J. Brewer, New York, N. Y. App. filed Nov. 18, 1901. The stem supporting the zinc element is attached to the latter by means of an insulating sleeve which permits of the attachment of a new zinc to the old stem, thus effecting an economy in the use of zinc.

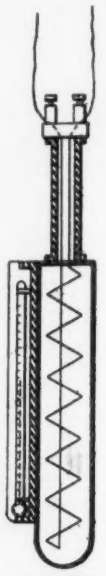
694,092. ALTERNATING ELECTRIC CURRENT INDUCTION MACHINE; Ernst Danielson, Westeras, Sweden. App. filed June 11, 1901. (See Current News and Notes.)

694,105. DEVICE FOR STARTING ALTERNATING ELECTRIC CURRENT INDUCTION MOTORS; Karl A. Lindstrom, Sommarro, Sweden. App. filed Dec. 29, 1899. (See Current News and Notes.)

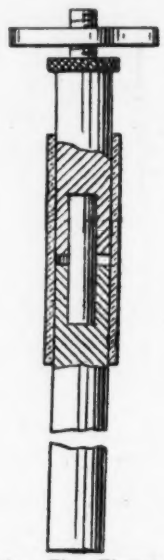
694,152. TROLLEY STAND; H. Holland, Detroit, Mich. App. filed Aug. 28, 1901. The trolley base is fitted with rollers which run freely upon a circular horizontal plate having unwardly turned confining flanges.

694,158. AUTOMATIC CONTROL SYSTEM FOR ELEVATORS; B. N. Jones, East Orange, N. J. App. filed April 30, 1901. A push button system by means of which the passenger can send the car to any desired floor, and which includes an automatic lock preventing the operation of any push button after one has been set.

694,190. ARC LIGHTING SYSTEM FOR ALTERNATING CURRENTS; L. and A. Privat, Oak Park, Ill. App. filed June 10, 1899. Alternating arc lamps in the secondary circuit of the transformers are cut out automatically by means of a shunt around the primary coil, which is closed by the expansion of a body of mercury.



694,018.—Electric Heating Device.



694,089.—Zinc Element for Primary Batteries.

694,220.—Former for Filaments for Incandescent Electric Lamps.

694,218. TROLLEY; J. S. Van Leer, St. Louis, Mo. App. filed May 9, 1901. An arrangement of guard plates preventing the wheel from leaving the wire.

694,220. FORMER FOR FILAMENTS FOR INCANDESCENT ELECTRIC LAMPS; G. C. Webster, Warren, Ohio. App. filed Dec. 30, 1901. A shaping implement having two opposite spiral grooves leading downward from its upper end, into which the filaments are deposited preparatory to baking.

694,239. THERMO-ELECTRIC ALARM; H. Black, New York, N. Y. App. filed May 18, 1901. A block of fusible material normally confines a spring contact under tension.

694,293. DYNAMO ELECTRIC MACHINE OR MOTOR; W. R. V. Marshall, Paisley, Scotland. App. filed Nov. 6, 1901. The pole faces are made up of plates of iron or steel with intervening non-magnetic spaces for the purpose of checking the reaction of the armature.

694,311. ELECTRIC CIGAR LIGHTER; J. M. Althouse, Reading, Pa. App. filed June 26, 1901. Details.

694,317. ELECTRIC TRACTION ROAD; L. Dion, Boston, Mass. App. filed June 22, 1901. A flexible conductor in connection with the main conductor passes into a closed tubular chamber and is supported at each end thereof. Between its points of support it is looped and connected with an armature which can be lifted by a magnet on the car into contact with buttons in the roadway.